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HOW a hydro-electric tunnel construction program in California had to be revised to take care of heavy water flow

Caribou Tunnel Driven Under Heavy Inflow of Water

By W. D. Shannon

ANOTHER structural article by R. Fleming of the American Bridge Company, in which are given experience notes on safe practice and other data on

Steel Coal Bin Designing

SOME new conclusions and further proof of existing beliefs are abstracted from a U. S. Bureau of Mines Technical Paper on

New Data on Compressed-Air Sickness

HOW a New York contracting firm is constructing a 124-mile meter-gage railway in South America

Bolivian State Railways Being Built by Americans

Also—

Several Letters About Licensing

Pumping Seven Million Gallons of Water Daily from One Shaft of the Caribou Tunnel in California

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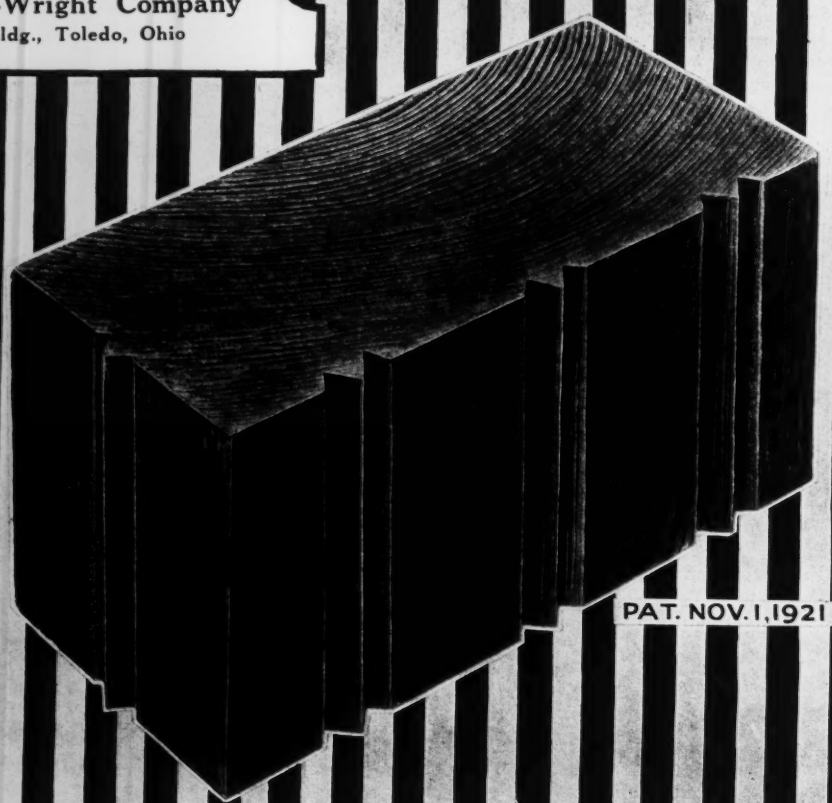


A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 — NEW YORK, AUGUST 31, 1922 — Number 9

Dramatic Elements

LAST week we commented on the President's duty of making dramatic the issues in strikes affecting the national welfare. Sometimes, though, the strikers do their own dramatizing. If they had had a movie scenario writer as strike director they could have devised no incident better suited to rouse the public than the abandonment of trains on the desert. The public "got" the situation. But it did not applaud. It roared its disapproval. Some minor "stunts" are being staged by the director. Some tracks have been dynamited, some buildings destroyed, some men maimed, some killed. The action is effective. It intimidates a few but rouses the many.

A Fifty Per Cent Rating

ANY time the engineer may harbor the notion that the business world has great respect for his scientific methods and accuracy, he might ponder the following quotation extracted from an address by an official of the Department of Commerce to an organization of business men. He is discussing the much-heralded report on Waste in Industry, which has been regarded as an outstanding contribution of American engineering science to the business community. "This report," says the speaker, "shows that on the average these six industries are being operated with a waste of 40 per cent. Forty per cent of the capital, material, labor, mental effort just thrown away with nothing to show for it! *Of course, it's an engineer's report and some of you may want to discount the technical man's findings, but surely you will admit these engineers are at least half right* and that would mean a waste of 20 per cent—$1 out of every $5 destroyed." The italics are ours. Comment is needless.

A Rare Tribute

FEW engineers ever have received or ever will receive a tribute comparable with that accorded to Herbert Hoover by Ex-Governor Cox of Ohio, Democratic candidate for President in the last election. In a summary of the European situation published in *The New York Times*, Governor Cox says: "Our government * * * should designate Herbert Hoover, now a member of the Cabinet, to serve in the reparations task. He holds the confidence of Europe. Peoples and governments trust him. He can analyze the economic situation of Germany. His decision as to what Germany can pay beyond much question of doubt would be accepted by France—and that means by all the parties interested. I believe every Chancellery in Europe would welcome his coming. The mere announcement of his selection would stabilize things. With reparations adjusted, Germany and France—both in need of large loans—would be given credit, and Austria, too. Then would come the dawn of a new day. Mr. Hoover is not of my political party, but any one in as close touch with Continental conditions as I have been is thoroughly stripped of every partisan thought."

The Royal Road?

THOSE who favor state licensing as a means to establish more securely the professional standing of engineers—"to make it a *real* profession," as one advocate has said—may be encouraged to learn that advertising men are thinking along similar lines. In the Advertising Club of Pittsburgh a movement is afoot to urge a state code making it "obligatory on the part of every man or woman in Pennsylvania entering the profession of advertising to pass a board examination if he or she is to become an A.C. or Advertising Counsellor." Those who pass the examination would be entitled legally to sign the initials, "A.C." after their names. The purpose of such a measure has not transpired, but we doubt not that, ostensibly at least, it is intended for the protection of the public. Would it tend also to the same degree as with engineering, to make a *real* profession of advertising?

A Stampede Unlikely

FAILURE has attended the efforts of the train-service brotherhood leaders to mediate between the railroad executives and the striking shopmen. Most of the executives stood pat on their earlier decision with regard to seniority. So did the shopmen. A minority of the executives whose roads had taken on but few new men, proposed a plan that would have met the seniority issue; but the leaders of the shopmen would not consider separate agreements. Thus does one issue succeed another as a barrier to peace. Meanwhile the roads carry on, declaring that they expect to meet every demand for equipment. The President is very unwilling to have the government undertake either railroading or coal-mining except under stress of direct emergency. This reluctance is an encouraging indication that we are not to be swept on a wave of agitation into the gulf of government ownership. We hope that the President will make this so clear and unmistakable that hope of using the strike to throw either mines or railroads into government hands will be abandoned by any who may now cherish it.

New Promise in Air Flight

A GERMAN student has managed to remain over three hours in the air in a motorless sailplane or glider. Perhaps, after all, the treaty provisions which forbade the construction of high-powered airplanes in Germany and which caused such a piteous outcry from the vanquished will react to their benefit. Little is known, even yet, of the laws governing mechanical flight but we seem to have progressed since the days of the

war when the principle effort was to develop engines of higher and higher power. Designers knew then that the more power they could crowd into a plane the faster it would fly and they had no time to devote to scientific research or to plane refinements. As a result we had single-seaters propelled by motors of 300 hp. and upwards, economic monstrosities. Apparently we are about to go forward from the point where the Wright brothers left off. They were principally concerned with discovering means of control and they were successful. The present-day gliding tests begin with a very fair knowledge of the control factor and aim at further advances in the knowledge of the laws of sustained flight. Germany is off to a good start. It is not too much to say that we are on the threshold of a revolution in the science of flying. The German demonstrations seem to open up unlimited opportunities for reducing the power required to propel heavier than air machines.

The Mission of the University

WHAT should be the aim and function of the University? This question is raised by the statement of Dean Eugene Davenport, of the College of Agriculture, University of Illinois, reported elsewhere in this issue, and by that of President Richards of Lehigh University, reported on page 320 of last week's issue of this journal. Dean Davenport declares that the objective of education has been shifted from the man to the activity, with a corresponding shift of emphasis from instruction to research. President Richards believes that it should be the purpose of real universities to place scientific research and the advancement of knowledge in a position of equal importance with the work of instruction.

No one will question the value of scientific research, intelligently conducted. No one can doubt the value of experiment stations and research laboratories, conducted either privately for the benefit of an industry, or by the state for the benefit of its citizens. Few, moreover, will question the benefit to a professor, or an instructor, of a certain participation in research work. Few, therefore, will doubt the advantage of having research carried on as university work, provided it can be done without prejudice to the essential work of the university, which we conceive to be the education of those who seek instruction from its faculty.

We speak, of course, from the viewpoint of the engineering schools, which just at this time are taking serious thought to their efficiency in ministering to the needs of the community. But their concern has not arisen because of a dearth of scientific research or a failure to contribute to the fund of engineering knowledge. Quite to the contrary, the complaint of industry is addressed to the preparation of technical graduates. The uneasiness of the profession concerns its personal capacity to assume broader responsibilities of citizenship, and the care of organized engineering educators is to clarify their objectives and overhaul their methods for the training and education of their students.

On every hand today the demand is for better-trained men, and this does not mean men with more information or even greater technical skill. It means men of broader vision, of more fundamental knowledge, of more alert perception, of more earnest purpose, of greater industry, and of more human instincts. These, with the exception of the second, are qualities of character, which are developed not by book, or precept, or yardstick, but by contact with instructors of profound human sympathies, who will "teach the student rather than the subject." The faculty, therefore—at any rate that of the engineering school—should be selected with this end in view, if the schools are going to rise to the opportunity that is before them and give to the community more efficient engineers, wiser citizens, broader men.

Now and then we meet a professor, or instructor, who can do this work, and who is a competent research worker besides. But the combination is rare. Our judgment is that commercial research is so important and so necessary that it should be conducted with every needful facility by specially selected and specially trained staffs. To attempt this work with a staff charged also with the duty of training and inspiring the usual body of engineering students would do justice neither to the research nor to the community that is awaiting the manhood it expects from its university.

From a proposal to establish and strengthen research staffs at our universities there should be no dissent, provided the universities have the resources with which to carry on both research work and instruction. Neither will anyone question the value to the teaching faculty of a certain amount of original research, designed to stimulate and strengthen their teaching ability and kept strictly subservient to that purpose. But if, as is intimated by Dean Davenport, the emphasis is to be shifted from the training of the man to the ascertainment of knowledge intended for commercial application, those who are interested in the education of our youth should begin to seek other means than the university for the development of our manhood. But we are reluctant to believe that this opinion is shared by any considerable body of those who are responsible for the conduct of our engineering colleges.

Licensing Still an Issue

THE comment that has followed upon the publication in *Engineering News-Record* for July 6, of a discussion on the licensing question indicates that the profession still holds diverse opinions concerning it. The extracts published in this issue are representative of the three prevailing views: (1) That we should work for licensing; (2) that we should oppose it; (3) that we are getting it anyway so let us make the best of it.

Those who favor it subscribe to the principle that it must be justified by the needs of public safety and submit that it is so justified. They contend, however, that the profession has a right to consider and to accept whatever advantage may inure to it as a by-product of licensing, and that the development of higher standards in the profession will avert the danger of licensed engineers undertaking work for which they are incompetent.

Those who oppose licensing contend, in the main, that it is not required to protect the public and that it is, therefore, unjustifiable. Some charge much of the licensing promotion to selfish motives—largely the desire to restrict competition and to close the profession.

The attitude of the neutrals is best reflected, perhaps, by the comment of one of them that we should "guide the law-makers, so that the resulting legislation will do the least possible harm and, if possible, some good."

Most interesting of all, perhaps, is the evidence that

the opponents of licensing are organizing for the repeal of some of the laws. News has reached us recently of such action in two states. Information is not available as to whether similar measures are contemplated to forestall the enactment of laws where none now exist. Unquestionably, organized effort has had much to do with the enactment of most of the licensing laws and if their opponents adopt the same tactics the whole question will be more thoroughly aired than could otherwise be the case.

Denver's Water Problem

DENVER has another water-works report by consulting engineers. It is different from any of the long series made in the past. For the first time the impelling motive back of the employment of experts was not for or against private stockholder interests. The people of Denver own the plant now and the instructions to the consultants were to lay out a comprehensive program for the best interests of the city. In all previous history of the system reports and investigations of the many able engineers consulted had been made largely in support of legal contentions or for condemnation or rate-making purposes, without the interests of the water users having been represented by engineers free from leaning toward one or another side of a controversy.

While the report, which is abstracted elsewhere in this issue, deals somewhat with the past it is for the sake of giving a better understanding of the present engineering situation. Rightly, a plea is made to seal the historical pages of dissention. If enough voters can be educated to this viewpoint to put through a bond issue for the first steps in a far-reaching comprehensive program Denver may be spared the threatened water famine and become one of the large cities of the country. Water limits the size of the city, and particularly its expansion to embrace outlying districts which for the present need water chiefly for irrigation but ultimately, with plenty of water, would become urban areas. As William Mulholland told the Los Angeles city council when it was considering the Owens River $30,000,000 project, "If you do not go after this water you will not need it."

Startling as is the proposal in the report of the Board of Engineering Review to distribute all of Denver's water through Marston Lake, it is no more so than the idea of the city controlling and regulating all of the water that flows down the South Platte, both for municipal supply and for irrigation. As there are few people in Denver who do not realize that something must be done to get more water, the feasible and comprehensive program outlined should receive majority support.

The unit control of irrigation supply as well as domestic water for the Denver region is the logical thing to do from the engineering, management and financial standpoints. All that is needed is to bring this home to the electorate. Fortunately, Denver has a small percentage of illiterate voters. If the various civic organizations take up the task, aided, of course, by the societies of engineers, a serious campaign of education should meet with success. The irrigators need the continuity of service which unified administration promises, for, as the report indicates, irrigation near Denver is not satisfactory. Denver needs a prosperous backcountry. It must have more water within its boundaries or suffer for its lack.

Legal vs. Technical Opinion

IT IS commonly assumed that where a professional question of engineering comes before the courts, the legal decision rendered is also the best judgment of the technical aspects of the case. Cases occur frequently which bring this assumption strongly into question. Two recent ones are presented by the Ferris wheel collapse at Clason Point, N. Y., and the Knickerbocker Theatre indictment in Washington, in both of which cases the men brought into court were released. In the former case (p. 248, Aug. 10) the magistrate before whom the charge was examined took the view that an extraordinary gale was responsible for the failure. In the Knickerbocker case five defendants had been indicted, the architect, the building inspector and three contractors or contractor's employees, but the justice dismissed the indictment (p. 162, July 27), holding that it should have charged specific acts of omission or commission; for example, in what respect the plans and specifications prepared by the architect were negligently prepared and in what respect he failed to exercise the general direction and supervision of work.

To the technical mind, neither decision can be satisfactory as an interpretation of the engineering facts. In the Ferris wheel case the collapse occurred during a wind of 80 or 90 miles per hour, which exerts just about the pressure for which all structures are supposed to be designed. In other words, the wheel failed under a load that was not excessive or calamitous, and there is good reason for believing that at no time in its existence was the wheel adequately anchored to resist such wind pressure with due margin of safety. From an engineering standpoint, then, the case stands quite differently from the magistrate's legal interpretation, and it is patent that the accident demands technical investigation with a view to preventing its repetition.

In the Knickerbocker case the fact has been abundantly brought out that the building was dangerously defective in a number of ways and that the collapse resulted from one or more of its defects. The charge of negligence in design, execution and supervision is therefore so specific that no one could claim it unfair to be required to defend himself against it. Certainly it is specific as concerns the architect; his building collapsed, and the law on this point goes back at least as far as Hammurabi. The decision of the justice is, for the time being, equivalent to throwing the cases out of court and releasing the defendants as not responsible, and unless the ingenuity of the public prosecutor enables him to find indictments of more satisfactory precision, it amounts to a denial that any of the defendants are answerable.

The view of the lawyer and the view of the engineer are clearly not identical in these cases—and probably in many others. Nor is legal investigation of matters involving engineering questions an adequate safeguard to the public. Such roughly fashioned machinery for independent engineering investigation of important accidents as was brought into action to study the Knickerbocker collapse, resulting in the two reports which we published on pp. 532-38, March 30, should be applied also in future. Above all the young engineer should take warning that, as he builds up his sense of good and bad practice and of professional obligations and responsibilities, he will find sounder guidance in the engineering than in the legal view.

Caribou Tunnel Driven Under Heavy Inflow of Water

Unwatering Problems Paramount—200 Million Gal. Per Month Pumped From Shaft B—Water Pressure Prevented Use of Air Locks

By W. D. Shannon

General Superintendent, Stone & Webster, Inc., San Francisco, Cal.

THE construction program for Tunnel No. 1 on the Caribou hydro-electric development in California, which was completed last October, was originally laid out in the usual way for an ordinary two-mile tunnel job. Surface indications gave no warning of unusual conditions. As soon as the work was well under way, however, the actual sinking of shafts and advancing of headings became only a small part of the operation and the construction program had to be revised to give major time and attention to unwatering problems. Thus a phase of the work that could not have been foreseen called for the larger part of the time and money required.

Indifferent labor incidental to wartime conditions, soft material that would sink under timbering, and other ordinary tunneling problems were met. These were not unexpected, but the requirement that took precedence over all else was the unexpected necessity of handling countless streams of water that continually deluged the shafts and drifts, calling for more and more pumping equipment as the work advanced until each day became a 24-hour fight to keep the tunnel from flooding. Compressed air, as a means of unwatering the tunnel was not considered practicable because the inflow was under a head of about 150 ft. Pump breakdowns and uncertainty of power supply became very serious dangers and steam power plants were installed to avoid the flooding that promptly followed any interruption of the electrical current used for pumping. Pumping equipment was crowded into shafts and headings until there was barely room to pass men and materials and as much as 200,000,000 gal. per month were pumped against a head of 300 ft. from one of the shafts (see the view Fig. 1). By the time the work was finished a total of 2,000 electrical horsepower and 1,500 hp. in steam standby equipment had been installed for operating the pumps, hoists and other machinery used on the job. Despite all this there were times when the water won, temporarily, and headings were flooded for weeks at a time. Final success may be ascribed to the highest engineering skill supported by teamwork among the superintendents, foremen and mechanics on the job.

FIG. 1. PUMPING 5,000 GAL. PER MIN. FROM SHAFT B

The following notes on the driving of Tunnel No. 1 are confined largely to methods used in coping with the flow of water. No special importance attaches to the actual tunnel driving methods employed. The Caribou project as a whole was described in *Engineering News-Record* March 23, 1922, p. 472.

As finally completed Tunnel No. 1 is practically on the original location and conveys Lake Almanor reservoir water into Butt Creek, from which the Caribou plant draws its supply. The tunnel is 11,208 ft. long and has a finished cross-sectional area of 46 sq.ft. and a capacity of 900 sec.-ft. The driving of the tunnel was conduced from the upper and lower portals and from three shafts shown on the accompanying diagram, Fig. 2, as shafts A, B and C.

The tunnel penetrates the divide between the Feather River and Butt Creek, the northern portion of which was once a great valley that was afterwards filled in by successive lava flows, coming no doubt from Mt. Lassen. The southern portion of the divide is of shale, highly stratified and in many places badly broken. Both the lava and the shale were of loose texture, sufficient to make excellent water courses, this being proved by the quantity of water continually flowing from the heading and the completed drift.

The elevation of the reservoir averaged about 4,450, whereas the water table in the divide was slightly higher than this, showing that some of the water at least came from the mountains above the lake level.

Shaft B—The sinking of the shafts as far as the water table was a comparatively simple problem. Shaft B was begun in the early fall of 1919 and reached grade, 300 ft. below, in 90 days. The usual plan of providing two chambers in the shaft, a manway and a working chamber. was successfully carried out.

When the water table was reached, 173 ft. below the collar of the shaft, sinking pumps operated by compressed air were installed in the manway. The unreliability of the electric current supply soon compelled the construction of an auxiliary steam plant, which was kept in reserve so that the pumps could be quickly changed from air to steam.

When grade was reached, the quantity of water had increased to a point where it became necessary to construct an underground pumping station with duplicate steam and electrically operated centrifugal pumps; also a booster station located in the shaft above the water table. To facilitate unwatering the shaft a rod-connected pump with the motor located at the booster station and the pump within suction distance of the sump, was installed. In addition to this, a special motor-operated sinking pump of 3,500 gal. per min. capacity was installed in the shaft for emergency unwatering. With

the completion of the tunnel pumping station, the equipment could handle 7,000 gal. per minute.

As the tunnel excavation progressed down grade, pumping stations with motor-operated, centrifugal pumps were installed. These tunnel pumps discharged their water into a 16-in. wood stave pipe which emptied into the shaft sump, there to be pumped to the surface by the shaft station. In case of failure of the electric power, the heading would be abandoned, but the water would be kept down by the steam auxiliaries.

The ground water entered the tunnel chiefly from the west side, but as a rule the face and the entire tunnel for some distance back was a scene resembling a huge shower bath. This condition made progress exceedingly slow at times, though occasionally a dry face would appear, when excellent progress, as high as 26 ft. per day, would be made. This, however, was an unusual condition. Keeping miners at work under the conditions noted was something of a task in itself. The character of rock encountered in the portions of the tunnel worked from Shaft B was chiefly broken lava, with occasionally layers of lava dust and boulders.

Shaft C—The sinking of Shaft C was begun in November, 1919 and continued without interruption until the water table was reached, when sinking pumps similar to those used in Shaft B were installed. This shaft soon developed considerably more water than the other, and the difficulties were increased by striking a stratum of fine lava resembling quicksand. From this point on progress was exceedingly slow. Grade was eventually reached at a depth of 400 ft. and the shaft turned to the tunnel. A tunnel pumping station was then installed with electrically-operated centrifugal pumps and an auxiliary set of steam pumps.

The tunnel to the south of the shaft was in this wet sand, and breastboarding was necessary for a distance of nearly 700 ft. To hold the timber sets in place heavy sills were worked down into the sand until a bearing was reached, but even these sills occasionally settled, due to loosening of sand caused by water rising through it, and the set had to be raised, under much difficulty. The timber sets showed so much movement that it was decided to drive a pilot tunnel with square sets, and this small tunnel was finally completed.

While the south heading of the pilot tunnel was proceeding from Shaft C, the wet sand was encountered from the south portal driving north. A pilot tunnel was then resorted to in this latter drift and the junction of the two headings drained Shaft C through to the south portal, a distance of 3,888 ft. On account of the 700 ft. of wet sand, however, it was decided to continue pumping the drainage water up Shaft C until the sand section could be lined. Timber crews were started at each end of the sand portion to enlarge the tunnel to the proper size. It was proposed to line the sand portion with a reinforced ring of concrete with cutoff walls at each end of the sand section. As soon as the timber work was completed, the concrete invert was placed and the drainage water collected at Shaft C was then allowed to run to the south portal. About 4,000 gal. of water per minute was thus disposed of through the south portal without pumping, and the pumping machinery at Shaft C was dismantled.

The north heading from this shaft did not present any unusual problems except the wet ground. The water drained away from this heading and mining conditions were somewhat better on this account. The heading practically throughout the entire period of excavation was covered with small streams of water, making the working conditions disagreeable and the progress slow, though the rock work itself was not especially difficult.

Shaft A—The unusually wet conditions found in Shafts B and C soon convinced the engineers that the project could not be completed on time without the use of a third shaft near the upstream end of the tunnel. Work at the north portal of the tunnel showed that no different condition than those encountered north of the Shaft B could be expected throughout the north half-mile of bore. Shaft A was therefore decided upon, and work was started in the winter of 1919-20. This shaft was 200 ft. deep and was entirely in lava rock, and below the water table was alive with springs, compelling the same methods of unwatering as in the other two

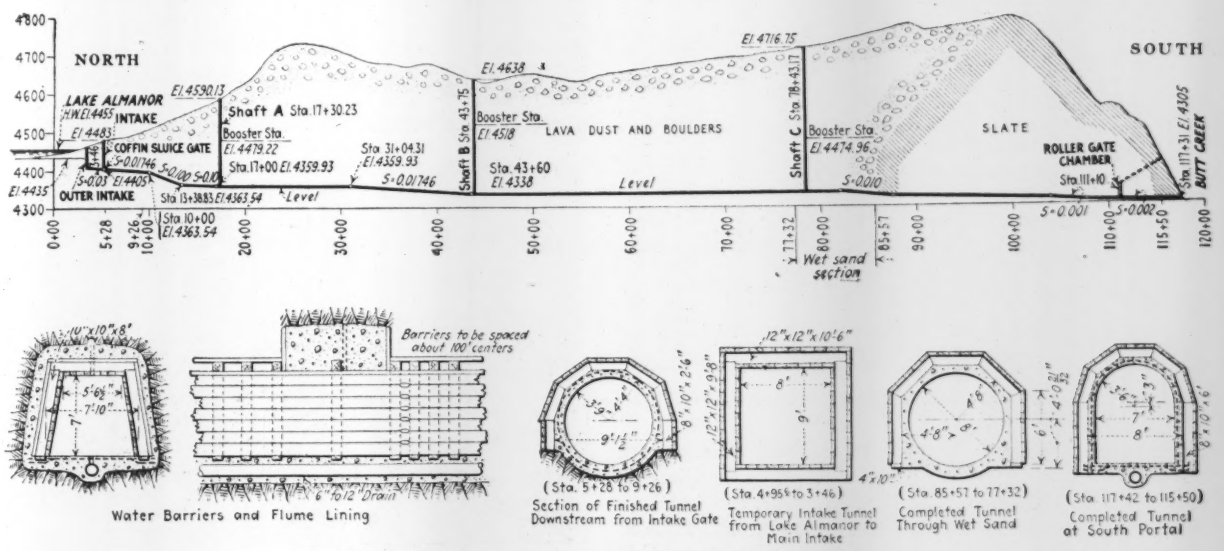


FIG. 2. CARIBOU TUNNEL NO. 1, PROFILE AND SECTIONS

shafts, with a similar tunnel pumping station at the bottom. When the heading between Shafts A and B had broken through, the problems of pumping were simplified somewhat; but an important advantage was that the pumping stations of both shafts were available in case of tunnel flooding.

South Portal—The south portal heading was largely in broken slate, the water in which was more or less in large veins. Water troubles in this portion of the tunnel were therefore intermittent, but in general the ground was wet for the entire distance. The slate varied from large blocks where the heading work was comparatively simple to broken slate the size of a pea. This latter ground possessed the peculiar conditions of weathering swiftly, and under the action of running

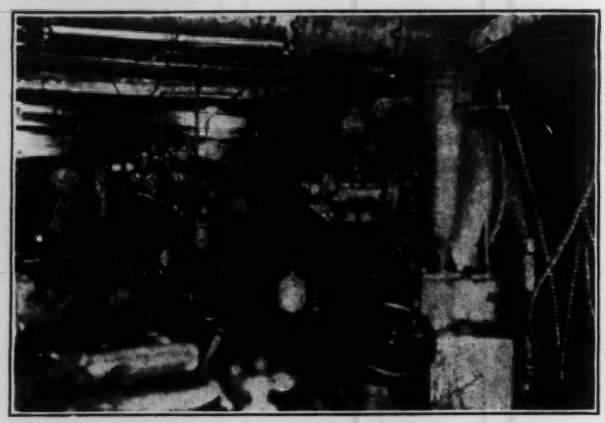


FIG. 3. CLOSE QUARTERS IN SHAFT PUMPING STATION

water was quickly softened. Ground of this nature compelled tight breastboarding, and progress through it was exceedingly slow. At Sta. 85 + 57, the wet lava sand was encountered and the pilot-tunnel method already referred to was adopted in driving from this point northward.

There were no pumping problems in connection with the excavation of this portion of the tunnel, as the water ran away from the heading and out of the south portal. About 4,000 gal. per min. was the maximum stream flowing from this part of the tunnel.

North Portal—The sill of the tunnel intake was only 50 ft. below the high-water level of Lake Almanor, and a slope adit was therefore driven to meet tunnel grade. Some of the wettest ground in the entire tunnel was encountered at this point, below the lake level, and on account of the hazards involved it was decided to construct only a portion of that part of the tunnel between the intake and Shaft A but to construct immediately the intake and install the Coffin gate as a protection to the balance of the tunnel. In addition to the protection of the gate, it was decided to leave a 70-ft. plug of rock between the Shaft A North heading and the intake, to be removed only when the rest of the tunnel was completed. The rock plug was located about 400 ft. south of the gate, and was the last portion of the tunnel to be driven.

Lining—Except in the wet-sand section at Shaft C, the south portal, and the portion of the tunnel immediately south of the intake, a standard lining (A in Fig. 2) was used. The floor of the tunnel was covered with a 9-in. slab of reinforced concrete, and at intervals of 100 ft. a concrete barrier 4 ft. wide was placed, to prevent a flow of water outside the tunnel lining. These barriers were poured against solid rock and were carefully grouted. The sides and roof of the standard section were covered with 3-in. surfaced planking carefully fitted and heavily spiked. The timber lining was put on after the concrete floor slab was in place.

To place the floor slab, a section of tunnel from 200 to 400 ft. long was dammed off by means of sack dams about 2 ft. high, a centrifugal pump installed at the upstream end, and the drainage water pumped over the section through a wood stave pipe. The floor was then trimmed to grade, with a 12 x 12-in. ditch in the center, in which was laid a tile drain to take care of small springs flowing into the section. After the reinforcing steel was hung in place, concreting was started at the downstream end of the section, the advancing concrete forcing the water through the tile drain in the completed floor. The floor was allowed to set several days before the upstream dam was broken and water permitted to flow over it. By thus taking a small section at a time, the work of concreting progressed rapidly, as

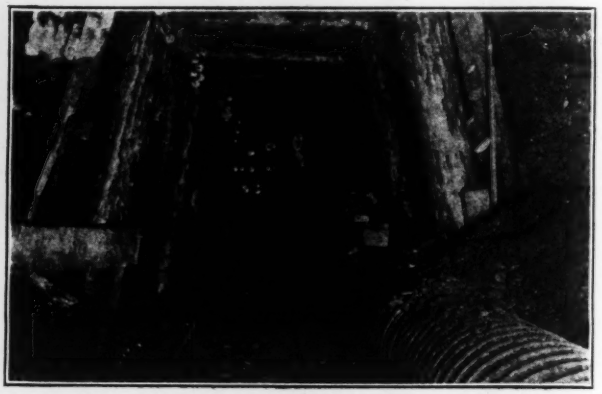


FIG. 4. PILOT TUNNEL THROUGH WET-SAND SECTION
16-in. wood-stave pipe carries water to shaft sump

the same system was used simultaneously in other portions of the tunnel.

Special sections and types of lining used elsewhere in the tunnel are also shown in Fig. 2.

At the tunnel outlet, a wooden flume built on pile bents and stringers, and terminating in an apron consisting of a reinforced concrete slab on a heavy pile foundation, was used to break the force of the water as it left the tunnel and to carry the water clear of the tunnel lining.

Flow Regulation—In order to control the flow of water through the tunnel, a 7-ft. Coffin gate was placed at the intake, and a roller gate at the lower end of the tunnel. The Coffin gate is to be used to shut the water from the tunnel entirely or to admit a full flow. The roller gate is designed to let through a partial flow, and at the same time to keep the tunnel under pressure. Both gates are electrically operated with local control.

The tunnel was placed in operation July 22, 1921. The entire development was constructed for the Great Western Power Co. by Stone & Webster, Inc. S. L. Shuffleton is the western manager of the company, and the writer was engineer-superintendent in direct charge of the work.

Data on Compressed-Air Sickness

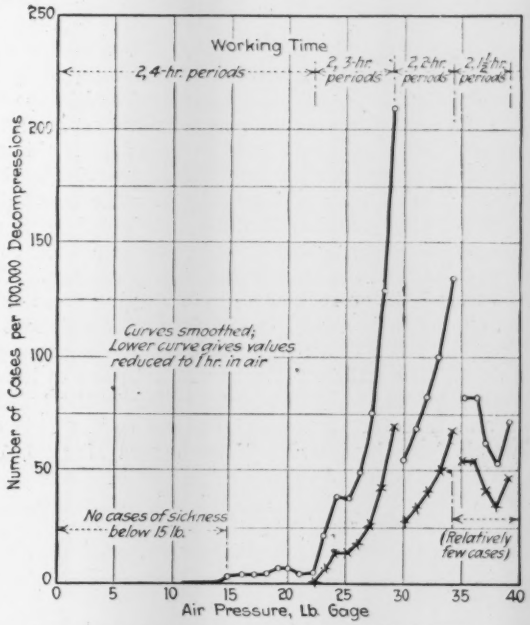
New Conclusions Reached and Existing Beliefs Strengthened in Bureau of Mines Report

BRINGING together the experience with compressed-air sickness obtained in the work of driving the Public Service Commission's rapid transit tunnels under the East River at New York within the past half dozen years, Dr. Edward Levy, in a report just issued (*Technical Paper* 285, Bureau of Mines) presents a number of conclusions differing from those previously accepted, or confirming prior views with better evidence. The total number of decompressions for these tunnels was 1,361,461, in which occurred 680 cases of compressed-air sickness. Data from the driving of the Pennsylvania East River tunnels, with 557,000 decompressions and 3,692 cases of sickness, are also taken into account after a report published by Dr. F. L. Keays in 1909.

Physical perfection in the worker is concluded to be less important than was formerly believed, on the basis of experience with mediocre workers during the war; the essentials are normal lungs, normal kidneys, and a good heart, and in older men a blood pressure not too high. Data on the influence of age are uncertain, but 87 men known to be over fifty years old developed only three cases of sickness, indicating that "in selected men advanced age may not be such an important factor as many writers insist." Obesity is not found to be an important factor; Dr. Levy says that "Men with a moderately-increased amount of adipose tissue are not more susceptible to compressed-air illness than is the average individual," and in consequence "he is less inclined than are some others, to enforce strictly a rule that no man with a tendency to fatness be employed." The outside temperature does not appear to be a factor in the incidence of compressed-air sickness, nor was humidity found to have any distinct effect.

As to the effect of pressure, it is noted that all of this work proceeded under the New York State law, which limits the working hours to eight (in two periods) for pressures up to 22 lb., two 3-hr. periods with a rest interval of 3 hr. for pressures from 22 to 29 lb. inclusive, two 2-hr. periods with a rest interval of 2 hr. for pressures from 30 to 34 lb. inclusive, two 1½-hr. periods with a 3-hr. rest interval for pressures from 25 to 39 lb. inclusive, two 1-hr. periods with a rest interval of 4 hr. for pressures from 40 to 44 lb. inclusive, and two ¾-hr. periods with a rest interval of 5 hr. for pressures from 45 to 50 lb. inclusive. The number of decompressions and the number of cases of sickness are given by Dr. Levy for working pressures varying by pounds. Reducing his figures to number of cases of sickness per 100,000 decompressions, and smoothing out the individual figures somewhat, the upper curve of the diagram herewith is obtained. The marked falling off in number of cases from 29 to 30 lb., due to the decrease in working hours from 3 to 2 hr., indicates that the time spent continuously under air pressure is an important factor. Further reducing the figures, therefore, to a basis of one hour's work, the lower curve of the diagram results. The sharp rise of the curves with pressure, and the abrupt decrease as the working time is decreased, still appear unmistakably.

Dr. Levy agrees with earlier investigators that the saturation of the tissues of the body with nitrogen is the cause of the compressed-air sickness. Carbon dioxide was not found to have any effect, within the close limits of control maintained on the Public Service Commission work, where the partial pressure of carbon dioxide reached 1 per cent only on two or three occasions. The symptoms in 92 per cent of the cases were localized pain in the body (chiefly pain in the joints), vertigo in 6½ per cent, and affections of the central nervous system (numbness, paralysis, etc.) in 1.6 per cent. Two deaths occurred, from choking and collapse respectively. These distribution percentages agree very closely with corresponding ones for the Pennsylvania



RELATION OF COMPRESSED-AIR SICKNESS TO AIR PRESSURE

Plotted from Dr. Levy's statistics of New York rapid-transit tunnel construction. Upper curve, cases per 100,000 decompressions; lower curve, same per hour working period. Both curves smoothed somewhat.

tunnel work. The disease showed itself within the first hour after decompression in 64 per cent of the cases (86% on Pennsylvania work), and no case developed after 18 hr. (23 hr.).

Treatment of compressed-air sickness, according to Dr. Levy, is most effectively conducted by providing medical air locks and arranging to have all the workers who may be taken sick, whether on or off duty, brought to the medical lock for recompression. He advises ample time of recompression, particularly in the more severe cases. Among his other suggestions are that decompression by the stage method should be based on an initial drop of pressure to not less than half the gage pressure (instead of half the absolute pressure), that chilling due to the cooling in decompression be avoided, that changing of men from one shift to another be avoided as tending to disturb living conditions and likely to induce anemia, and that the limits of working hours based on pressure be changed by lowering the upper limit of each class, so that, for example, the length of working period for pressures of 29 lb. and 34 lb. would be reduced, to eliminate the high peaks of the diagram curves.

Special Formwork Required in Setting Wharf Piers

Concrete Poured by Tremie Into Form Boxes Made of Timber and Steel Sheetpiling According to Profile of Foundation Rock

By S. Kent
Engineer, P. J. Carlin Construction Co., New York City

Some rather unusual features were included in the construction of a concrete wharf recently completed as part of the installation of the new steam power plant of the United Electric Light & Power Co. at 134th St and East River, New York City. The sequence of operations in the construction of the entire plant, the limited space for the storage of concreting materials, and the general congestion both on land and in the river made the construction of the wharf piers quite difficult.

General Dimensions—The concrete wharf is about 475 ft. in length and varies in width from 70 ft. at the north end to 24 ft. at the south end. The foundations for this wharf consist of walls reinforced with steel cages at the ends to carry heavy concentrated superimposed loads of the steel-frame superstructure. These walls were built on rock at a grade varying from –17 ft. 5 in. on the inshore end to –35 ft. at the outshore end (zero being the mean low water at the nearest gage station). The walls serving as support piers to the concrete wharf were placed perpendicular to the bulkhead line and therefore somewhat oblique to the face of a sea wall (see *Engineering News-Record* May 26, 1921, p. 896) which carried the loads imposed by the river wall of the main steam power-plant superstructure. The wharf piers were generally 6 ft. wide by 31 ft. long.

Inspection of the river bottom revealed that for a distance of about 16 ft. on the inshore end the rock bottom was fairly level at -17.5 and for the balance of the pier length the rock dipped sharply to -35, at which grade the rock at the end of the wall was blasted to give a level seat, about 6 ft. square.

Form Details—A wooden form built in panels was therefore decided on for the inshore 16 ft. of wall and steel sheetpiling for the balance of the long sides and a wooden panel for the deep end. The three wooden panels on the inshore end were bolted together and to the open ends of this box form were bolted half pieces of steel sheathing. This box was securely braced and stiffened with steel I-beams or channels which also served to sink the box.

The overall height of the box was 28 ft. as the top of the wall was approximately at an elevation of +10. The boxes were built on a lighter and set in position by it and were securely braced to the sea wall and to the walls previously poured. After the boxes were satisfactorily placed wales, consisting of I-beams or channels built as shown in the accompanying view, were fastened to the box by 1¼-in. tie rods and supported at the outshore end by I-beams set on rock bottom. The ends of these wales above low water were guyed by cable to the sea wall or were braced to the walls previously concreted. After the wales were set at low and high water, sheetpiling was driven (locking at the ends of the open boxes with half-pieces of sheathing bolted to the box form) out to the outshore end of the wall on both sides.

A wooden panel with pieces of sheetpiling bolted flat on the ends was then lowered locking into both end pieces of sheathing, thereby making a complete inclosure. The box form was bolted securely at the corners and rodded across. At two points below low water 1¼-in. round tie rods were installed, to which wales, consisting of pairs of I-beams, were attached by divers. The wales were so built up that the sheathing was tight against the wales and lined up with the wood form.

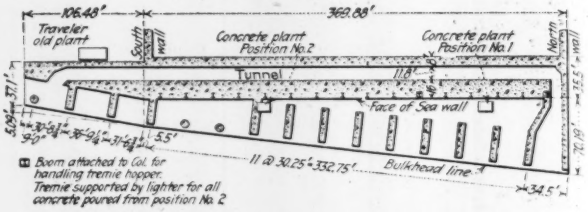


FIG. 1. LAYOUT OF PIERS—POSITIONS OF CONCRETE PLANT

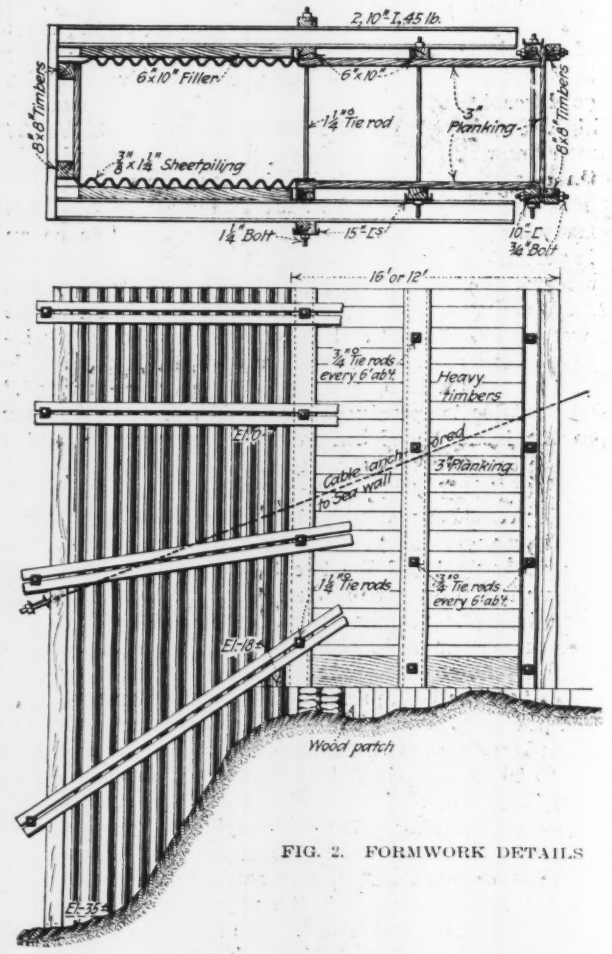


FIG. 2. FORMWORK DETAILS

The two ends were rodded across as shown on the plan with 1¼-in. rods to take up the pressure on both ends.

The wooden forms did not fit tightly against the rock foundations so it was necessary to patch on the inside with 2-in. planking set vertically. The entire outside of the box was bagged up with burlap bags filled with gravel to prevent leakage at the bottom.

Concreting Operations—To concrete the wharf foun-

dation walls with the tremie, work was laid out so that a mixing plant set at Station 1, as shown on the accompanying plan, would take care of about one-third of the work. It was then shifted to Station 2 to cover the second third of the work. The third or southerly portion of the pier concreting was handled from a stationary plant.

The plant at Stations 1 and 2 consisted of an 80-ft. wooden tower guyed to the steel superstructure, a 1-yd. mixer, a 25-yd. bin supported on timber bents set down on rocks, and a hoisting engine set on the sea wall. To support the tremie a wooden boom was set on various steel columns and was attached to the base of the columns with a Chicago boom fitting. During concreting the tremie was operated from an engine in the same manner as from the traveler plant, described in the article referred to above.

Handling Materials—The concrete was of a 1:2:4 mix. Aggregate was handled from scows kept alongside by a derrick on the lighter into the bin. Cement was carried off the barges and deposited in piles near the mixer and carried up to the working platform when needed. Concreting of walls was done in three stages: First, pouring concrete to the level of the highest point on the rock bottom; second, pouring up to low-water line, and, third, topping on the walls. Reinforcement was assembled on shore and lowered by the lighter immedately before any concrete was placed.

Before any formwork was put in place the entire site was cleaned of boulders and loose material to hard rock, so that all work necessary after the forms were in place was little more than to clean the bottom with an 8-in. material pump and patch up around the bottom.

The wharf deck consists of a steel framework supporting concrete slabs 8 in. thick, reinforced with wire mesh. The centering was similar in construction to that for concrete floors on a steel beam-and-girder construction. The beams at the ends of the walls were tied together to afford a rigid lateral tie for the 6-ft. walls.

The stripping of the walls was very simple. The panels were loosened up by removing the nipples and the sheathing was then removed, starting with the pieces next to the side panels.

The construction of this wharf and the piers was done by the P. J. Carlin Construction Co., New York City. E. A. Herrick was general superintendent and the writer engineer for the contractor on the job.

New Geographic Positions in Rocky Mountains

Geographic positions and elevations of triangulation stations on the newly surveyed Utah-Washington arc of precise triangulation are published in Special Publication 74 of the U. S. Coast & Geodetic Survey, just issued. The arc extends from near Ogden, Utah, through southern Idaho to the Columbia River at Umatilla, and thence down the Columbia to near Portland, Oregon. The extremities of the arc were tied into adjusted triangulation, which was not changed in position by the adjustment. In addition to giving the data on the stations, including descriptions of the stations, the publication sketches the methods and costs of the entire triangulation, and deals with the magnitude of the discrepancies distributed by the adjustment. It gives also an explanation of the North American datum and a brief statement of the advantages derived from using points on that datum for the control of local surveys. Methods for using such points are suggested.

The Record-Breaking Rainfall and Flood at Fort Worth, April, 1922

THE unprecedented electrical storm, rainfall and flood at Fort Worth, Tex., of April 24-25, with its 8.81 in. of precipitation in 24 hours (actually in 14 hr. 22 min.) and its river flood height of 39.1 ft., or 0.1 ft. above any previous record (see *Engineering News-Record*, May 4, p. 749, for news report) is the subject of an article in the April *Monthly Weather Review* by D. S. Landis, local meteorologist of the United States Weather Bureau.

Rain began falling at 9:06 p.m., April 24. From 10:19 p.m. to 7 a.m. the next day (8 hr. 41 min.) the total precipitation was 7.5 in. The maximum fall in inches for various short periods were: 15 min., 1.02; 30 min., 1.74; 1 hr. (12 to 1 midnight), 2.5; 2 hr., 4.07. The accumulated depths for successive periods are shown in the accompanying table.

ACCUMULATED RAINFALL AT FORTH WORTH, APRIL 24-25, 1922

First line, time in minutes; second line, corresponding rainfall in inches.

5	10	15	20	25	30	35	40	45	50	60	80	100	120
0.06	0.14	0.31	0.54	0.70	0.75	0.89	1.28	1.63	1.89	2.43	3.07	3.62	4.07

The drainage area of the Trinity River above Fort Worth is 2,300 sq.mi. Reports from two points in the upper part of the area "warrant the belief that the torrential rains covered the whole drainage area."

Previous Heavy Rainfalls at Fort Worth—On Sept. 20-21, 1900, 7.44 in. of rain fell within 24 hours, causing an estimated flood depth of 38 ft. On May 24-25, 1908, there was a precipitation of 6.99 in. within 15 hr. and 13 min., resulting in a flood stage of 39 ft., "estimated from ripple marks on bridge." In both these cases the rise of water was slow and but little destruction resulted.

Effects of April, 1922, Flood—Mr. Landis describes the latest flood and its results as follows (except for slight condensation):

The floods were of little moment to property or life, but had other factors not found in former floods. The river proper at the Government river-gage is 98 ft. wide in channel. Back 100 ft. from the channel a 10-ft. high levee was thrown up and grassed over. This levee gave a channel practically 298 ft. wide, and 30 ft. to river-bed level, supposedly allowing sufficient channel for any flood waters likely to occur. The test came the morning of the 25th. At 7 a.m. the river-gage showed 33.5 ft., being 3.5 ft. above flood stage with water running over the levee. No one knows how long the levee had been overtopped for the rainstorm had been so intense and the electrical storm so terrific that apparently no one had ventured out to note conditions.

The residential lowland district was under water before any one knew it, house pets giving first alarm by cries and scrambling for places of safety. People stepping out of bed found water ankle deep, and more, already in their homes, and the flood soon became waist deep. Ceilings were opened and refuge taken in lofts, and daylight found many people marooned on housetops awaiting rescue.

By 7:30 a.m. a crevasse was made in the levee some distance above the residential district, and the flood filled in rapidly, water running into residence windows by 10 a.m., and reaching the eaves of many homes by 2 p.m., when the flood crest stood highest of record at this station, 39.1 ft.

The lowland residential district embraces about 4 sq.mi. About 1,500 inhabitants were subjected to overflow waters. After the levee broke many head of live stock drowned in their stalls, at hitching posts, in wire entanglements, in hobbles and lariated, while many other animals were washed away.

Some Data on the Design of Steel Coal Bins

Experience Notes on Safe Practice—Weight and Friction Angle—Hopper Bottoms—Plate Thickness and Lining—Pressure Calculations—Bending Moments

By R. Fleming
American Bridge Co., New York City

PRACTICE in designing steel coal bins and bunkers varies considerably, without good reason. A discussion of the commonly available data and usual practices seems desirable as a help in clarifying the subject. The principal type of structure concerned is the overhead bin or bunker for the boiler room of a power house, which, located directly over the firing space, delivers coal direct to the stokers by gravity and provides for several days' storage.

The Paterson Accident—Study of coal bin design received an impetus from the failure of a large bin at Paterson, N. J., twenty-five years ago. A thousand tons of coal were dumped over boilers and machinery, breaking steam pipes and for a short time stopping street car and lighting service. Illustrations of the structure that gave way, together with a spirited and

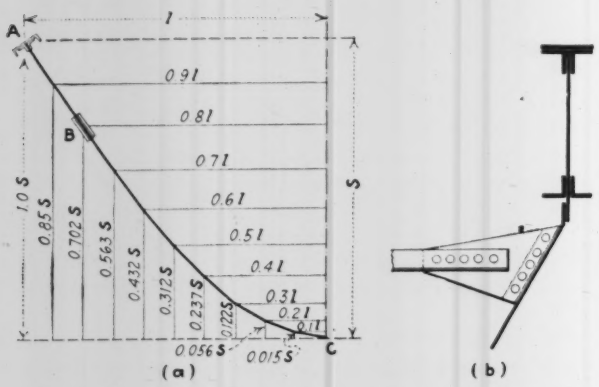


FIG. 1. CURVE OF SUSPENSION BUNKER AND EARLY SUSPENSION DETAILS

extended discussion on bin design, may be found in *Engineering News* of Aug. 19 and 26, Sept. 23, Nov. 4 and Dec. 30, 1897. An important lesson taught by the failure, not yet fully learned, is that bins should be designed for any probable or possible surcharge. The builders of the Paterson bin wrote in defense of their design that it was distinctly stated in their proposal that the coal was to be level on top of the bin. However, the conveyor was placed 8 or 10 ft. above the top. A miners' strike was impeding and in order to accumulate coal the bin was surcharged to the limit of its capacity. This was the natural thing to do. There seems every reason that in calculating stresses for any bin the greatest load that can be placed in it should be used.

Weight of Coal—The weight of coal varies. A monograph, "Weights of Various Coals," by S. B. Flagg, Technical Paper 184 of the U. S. Bureau of Mines, gives the weight per cubic foot of 177 samples as determined by shoveling coal loosely into boxes measuring 2 ft. by 2 ft. by 2 ft. and leveling off with a straight edge. These weights justify the common practice of assuming the weight of bituminous coal at 50 lb. and of anthracite at 56 lb. per cu.ft. Coal in a storage pile or otherwise compacted or wet may weigh considerably more.

The angle of repose, or rather internal friction, is also a variable quantity. It has often been assumed at 30 deg. for anthracite and 35 for bituminous coal.

In designing bins to be located in coal breakers and washeries it may not always be advisable to follow the assumptions mentioned of weight and angle of repose. Local conditions may be different

Thus, the mechanical engineer of a coal company in Pennsylvania, while approving the assumption of 50 lb. and 35 deg. for bituminous coal for usual practice, notes a number of varying conditions. When finely crushed coal, either bituminous or anthracite, is deposited in bins by flushing with water it takes a very flat slope, anywhere between 5 and 35 deg. The size of the coal and the amount of water used in flushing affect the angle of repose. Large coal flushed with a small quantity of water will repose on an almost normal angle, say 27 deg., while with a large quantity of water its slope will decrease to 20 to 23 deg. Small-size coal such as rice or barley will take a slope of 10 to 20 deg. even when only a small quantity of water is used in flushing it in. Weights of coal also are variable, according to this engineer; anthracite coal absolutely free from slate or rock would weigh 54 to 58 lb. per cu.ft., but with much dirt or rock the weight may run from 60 to 65 lb., and bituminous coal varies similarly.

Sufficiently correct assumptions for practical use in calculations for bins in boiler rooms are: bituminous coal, 50 lb. per cu.ft., 35 deg. angle of repose; anthracite coal, 56 lb. per cu.ft., 30 deg. angle of repose.

Useful Literature—There is not much literature available to the practical designer on the subject of coal bin design. The engineer who has much work in this field should by all means own Ketchum's "The Design of Walls, Bins and Grain Elevators," preferably the latest edition. Cain's valuable "Earth Pressure, Retaining Walls and Bins," has a chapter on bins—mostly coal bins. Hess in his "Graphics and Structural Design," devotes a chapter to bins. An article "Some Formulas and Tables for Bin Designing," by R. W. Dull, *Engineering News*, Vol. 52, July 21, 1904, has been widely quoted.

Suspension Bunkers—The most common types of coal bins used in power stations are the suspension bunker and the hopper bin. Shortly after the failure of the Paterson bin, A. S. Berquist designed a bin for the American Coffee Co. of Brooklyn of steel plate suspended from two side girders; he patented it May 30, 1899. A description and an analytical investigation were given by Berquist in *Engineering News* of July 27, 1899, p. 54. The shape of the bunker is the curve of equilibrium for a cord suspended from two fixed points, carrying a load decreasing uniformly from a maximum at the center to zero at the points of suspension. The equation of the curve is

$$y = \tfrac{1}{2}\frac{S}{l^2}\left(3x^2 - \frac{x^3}{l}\right)$$

The maximum pressure, P, (at the center) for triangular loading $= \frac{Cw}{l}$. $H = \frac{Cwl}{3S}$; $V = \frac{1}{2}Cw$ and $T = \sqrt{V^2 + H^2}$. For a bunker level full, $C = 5/4\ lS$; $P = 5/4\ Sw$; $V = 5/8\ Slw$; $H = 5/12\ l^2w$.

in which (using Ketchum's notation) the symbols mean:

l = one-half the span, feet;
S = sag, feet;
H = horizontal component of stress in plates, pounds per lineal foot of bin;
w = weight of bin filling, pounds per cubic foot;
T = maximum tension in plates, pounds per lineal foot of bin;
V = reaction of bin, pounds per lineal foot;
C = capacity of bin, cubic feet per lineal foot of bin;
x, y = values of co-ordinates, with origin at lowest point of bin.

It is observed that Cw does not enter into the equation of the curve and that for a bunker level full S does not enter into the value of H. The curve may be laid out either analytically or graphically. Fig. 1a shows the ordinates in terms of l and S. If the bunker is surcharged by vertical walls the curve is extended until it meets the plane of the produced surface of the material; the half span l is then the distance from the meeting point to the center line and the sag S is the vertical distance from top of wall to lowest point of bunker.

It is common practice to make the upper portion of the curve a straight line and the lower portion the arc of a circle or the arcs of three circles. For a bin which is nearly an equilateral triangle the following figures (Hess) are approximately correct: Area of the bin section, fill level, $0.40L^2$; area of the bin section, triangular surcharge, $0.57L^2$; length of plate, no allowance for laps, $19.8L$ (inches); force in plate per foot of length at A (Fig. 1), $0.60W$ (pounds); force in plate per foot of length at C (Fig. 1), $0.30W$ (pounds); where L is the span in feet, and W is the load in the bin for one foot of its length (pounds).

The curve as determined from the theoretical equation is not strictly correct for bins partially filled, neither is the straight-line-and-arc strictly true for bins fully loaded; in fact, no curve is true for all conditions of loading. However, any deflection due to bending in the sides when the bin is not loaded as assumed is ordinarily not sufficient to cause trouble, either by distortion or by increase of stress in the plate.

Suspended bunkers have also been built with the curve a parabola, the ordinates of which are 0.01, 0.04, 0.09, 0.16, 0.25, 0.36, 0.49, 0.64, 0.81 instead of those shown in Fig. 1. A practically parabolic curve was used in one case, where the curve was determined by suspending a plate from two trolleys placed on a crane at points corresponding to the points of suspension and passing it through a third point corresponding to the lowest point of the bunker. From the suspended plate the drafting room obtained data needed for ordering material and making working drawings. The plates were laid out, punched and shipped flat leaving them to be bent at the site by the erector. A field difficulty arose from the fact that the plates with holes for discharge gates did not bend to the same curve as the other plates; these holes should have been cut in the field after erection.

For several suspension bunkers of concrete on ferro inclave the narrow supporting plates were shipped flat. At the site they were made to assume a predetermined curve by pulling them transversely with wires until tangent to wooden strips laid longitudinally.

Fig. 2 is the cross-section of a suspension bunker of decidedly different shape, built in 1915, the outline of which was suggested by Berquist a short time before his death. Several bunkers have since been built with almost identical outlines. It is observed that the supporting girders are vertical, thus enabling attachments

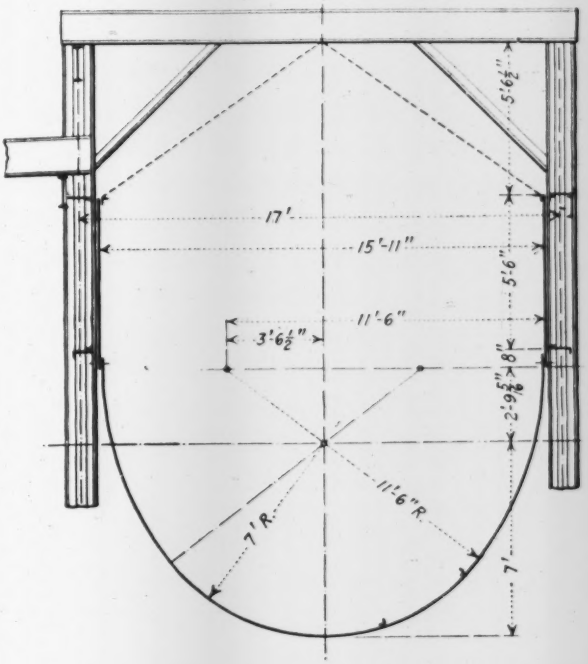


FIG. 2. LATER TYPE OF SUSPENSION BUNKER

to be easily made to inner flanges of columns. The top flange latticed to a vertical channel and a horizontal channel made part of the bottom flange prevent lateral distortion between columns. It is also observed that a greater storage capacity is obtained. On the other hand with the original form of bunker the curve is so nearly a straight line in its upper part that it can be made the web of a plate girder. The depth AB, Fig. 1 may be from $\frac{1}{4}$ to $\frac{1}{5}$ the distance between end supports depending somewhat upon the depth of the bunker. Two plates 7 to 12 in. wide serve for both tension flange and splice to attach the suspended plate.

The saving in steel by taking advantages of the tensile strength of the plates and thus avoiding supporting beams is considerable. Six Berquist bunkers ranging from 350 to 1,000 tons capacity, shipped, including supports, from 128 to 234 lb. per ton (2,000 lb.) of capacity, the average being 204 lb. These bins were designed in competition, and in some of them the thickness of plate could well have been increased. A weight of one-ninth of the contained coal for bin including supports and one-twelfth not including supports is usually a safe assumption (Kent gives these ratios in his "Mechanical Engineers' Pocket Book"). If the

bunkers mentioned had been of rectangular cross-section with hopper bottoms their weight would have been increased not less than 50 per cent. But the weights of bunkers and bins are dependent upon so many variables that no formula applicable to all cases can be given.

Suspension bunkers are not self-emptying. For this reason some prefer bins of the hopper bottom type. Concrete lining in Berquist bunkers may sometimes crack owing to the "breathing" of the bin from varying

TABLE I. COAL PRESSURES

Horizontal pressure on vertical wall 1 ft. long, in lb., for coal weighing 50 lb. per cu.ft., with angle of repose 30 deg.

	Top surface horizontal		Top surface sloping 30 deg. to the horizontal from each bin wall											
			Bin 15 ft. wide		Bin 20 ft. wide		Bin 25 ft. wide		Bin 30 ft. wide		Bin 35 ft. wide		Bin 40 ft. wide	
Depth in Feet	Total Pressure	Pressure on Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot
2	30	26	60	57	60	54	70	60	70	62	70	65	70	66
4	100	51	210	91	220	95	240	106	250	111	250	116	260	117
6	230	77	420	120	460	130	490	144	510	151	530	158	540	160
8	410	103	690	144	760	161	810	175	850	185	880	195	910	199
10	650	129	1,000	166	1,110	187	1,190	201	1,250	214	1,310	226	1,350	236
12	920	154	1,350	188	1,500	208	1,610	226	1,700	240	1,790	255	1,860	269
14	1,260	180	1,750	208	1,940	230	2,090	249	2,220	264	2,320	281	2,420	298
16	1,650	206	2,190	228	2,420	250	2,610	271	2,770	288	2,910	305	3,040	324
18	2,090	232	2,660	248	2,930	271	3,170	293	3,370	312	3,540	329	3,710	348
20	2,570	257	3,180	267	3,500	291	3,780	315	4,020	334	4,220	352	4,420	372
22	3,110	283	3,730	287	4,100	310	4,420	336	4,710	356	4,950	375	5,190	394
24	3,710	309	4,360	307	4,740	330	5,110	356	5,440	376	5,720	397	6,000	416
26	4,360	335	4,980	316	5,410	348	5,840	376	6,210	396	6,530	419	6,860	438
28	5,040	360	5,620	325	6,130	368	6,600	394	7,020	416	7,390	441	7,750	460
30	5,790	386	6,280	335	6,880	386	7,400	411	7,870	435	8,300	461	8,690	480

loads, but this has not been enough to prove a serious objection to their continued use.

The minimum thickness of plates for suspension coal bunkers should be ¼ in., and for large sizes preferably ⅜ in.

Hopper-Bottom Bins—Coal bins of the hopper type may be divided into two classes—those in which the plane of rupture cuts the top surface of the material within the bin and those in which the plane of rupture cuts the side of the bin. The second class, though common, has not received the attention that has been given to the first. Most of the methods given for finding the pressures on retaining walls are for horizontal areas of unlimited extent and do not apply to the many coal bins where the plane of rupture cuts the side of the bin.

TABLE II. COAL PRESSURES

Horizontal pressure on vertical wall 1 ft. long, in lb., for coal weighing 50 lb. per cu.ft.

Depth in Feet	Slope of Surface and Angle of Repose	Total Pressure for Bin 20 ft. wide	Total Pressure for Bin 30 ft. wide
12	15°	2,300	2,490
12	20	2,060	2,150
12	25	1,775	1,925
12	30	1,500	1,700
12	35	1,310	1,480
16	15	3,850	4,100
16	20	3,350	3,690
16	25	2,575	3,050
16	30	2,420	2,770
16	35	2,040	2,350
20	15	5,700	6,280
20	20	4,940	5,360
20	25	4,130	4,660
20	30	3,500	4,020
20	35	2,950	3,440

The writer for many years has used diagrams of lateral pressure made by a colleague, B. B. Priest. Fig. 3 shows one of these diagrams. (The method is adapted from that given in Church's "Mechanics of Engineering.") A tabulation of the diagrams is given in Table I. Pressures for angles other than 30 deg. are given for bins 20 and 30 ft. wide in Table II. The pressure in both Tables I and II for weights other than 50 lb. with the same angle of repose will vary directly as the weight.

A table used by the New York Central R.R., assumes the weight of coal at 52.1 lb. per cu.ft. and the angle of repose at 27 deg. The total pressure for depth d is $9.78\,d^2$ when the top surface is horizontal and of indefinite horizontal extent and $14.22\,d^2$ when the top surface is sloping at the angle of repose. These equations are derived from Trautwine's method for retaining walls. For bins of dimensions given in Table I the Trautwine method is needlessly severe.

Liquid-Pressure Calculation—Paaswell in his "Retaining Walls" mentions the method of using an equivalent liquid pressure for determining thrust against retaining walls. Dull, in his article previously referred to gives pressure-constants for several cases of bin loading for bituminous coal, anthracite coal, ashes and sand. His formulas, based on the theory of Cain, give the total horizontal pressure on vertical walls of steel-plate bins filled with bituminous coal (50 lb. per cu.ft., angle of repose 35 deg., top surface level), as $5.83d^2$; and on walls of bins filled with anthracite coal (52 lb. per cu.ft., angle of repose 27 deg.), as $8.39d^2$. For the same bins surcharged to the angle of repose, the corresponding figures are $16.75\,d^2$ and $20.6\,d^2$. These values are for the horizontal area of a bin unlimited in extent, which is seldom the case with surcharged bins. For bins, such as shown in Fig. 3, Dull gives no figures but recommends graphical computation.

Pressures for different depths of bin and weights of liquid are given in Table III. Comparing them with the figures of Table I it is seen that for bins with top surface of coal horizontal the lateral pressure is about equivalent to that of a liquid weighing 15 lb. per cu.ft. For the surcharged bins of Table I the equivalent weight of liquid varies from 15 to 25 lb. per cu.ft., depending upon the width and depth of bin. For angles of repose (ϕ) other than 30 deg., the remaining data being the same, the unit weight of the equivalent liquid is $\frac{(1 - \sin \phi)}{\sin 30^\circ}$ times as great; for example, if 15 lb. is the unit weight used for an angle of repose of 30 deg., the unit for an angle of 20 deg. is

$$\frac{1 - \sin 20^\circ}{\sin 30^\circ} \times 15. = \frac{1 - 0.342}{0.5} \times 15. = 19.74$$

The walls of some bins recently built for a coal breaker were designed by the writer for a liquid weighing 25 lb. per cu.ft. The conditions were not very well known and this weight was considered sufficient to take care of any probable contents with surcharge. Specifications of the Isthmian Canal Commission for 500-ton coal bunkers at Cristobal and Balboa called for the strength of framing to be proportioned on the assumption that the walls are subjected to the pressure of a

liquid weighing 25 lb. per cu.ft., and that "the bunker shall have the stated capacity without trimming; that is to say with the top surface of the coal at the slope which it would naturally assume as delivered by the conveying system." Each bunker was 23 ft. 8 in. wide in the clear, 16 ft. deep on the rear side and 40 ft. on the front.

Vertical Pressures—The walls of bins differ from ordinary retaining walls in that the material back of them is of limited horizontal extent. Due to friction of the filling material upon the sides of the bins, part of the load is carried by the walls. In grain bins of elevators, where the height is great compared with the width, this side friction is such that the walls carry the greater part of the weight of the contents. In coal bins the ratio of wall-height to width is small and side friction is also small. Dull uses angles of friction between coal and bin sides of steel plates of 18 deg. for bituminous and 16 deg. for anthracite coal in determining the pressures previously quoted. If side friction were neglected his values would be increased about 6 per cent. It is a slight error on the side of safety to omit consideration of wall friction in the design of coal bins.

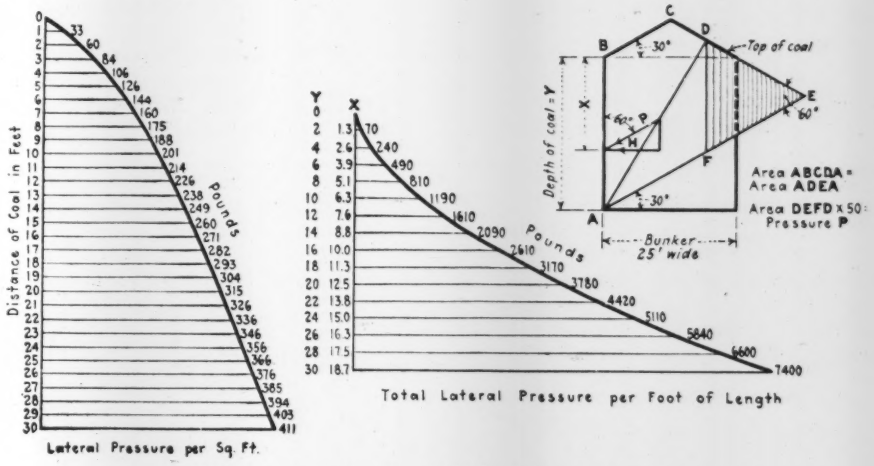

Distance of Coal in Feet
Pounds
Lateral Pressure per Sq. Ft.
Depth of coal = Y
Top of coal
Area ABCDA = Area ADEA
Area DEFD x 50 = Pressure P
Bunker 25' wide
Total Lateral Pressure per Foot of Length

FIG. 3. PRESSURE DIAGRAMS FOR NARROW BINS
Horizontal pressure per square foot and total pressure per longitudinal foot of bin, for coal of 50 lb. per cubic foot and angle of repose 30 deg.

TABLE III—LIQUID PRESSURES FOR VARIOUS UNIT WEIGHTS

Depth in Feet	Total Pressure on Vertical Wall 1 ft. long 15 lb. Per Cu.Ft.	20 lb. Per Cu.Ft.	25 lb. Per Cu.Ft.	Water 25 lb. Per Cu.Ft.	Pressure on Lowest ft. of Water, Lb.
2	30	40	50	125	125
4	120	160	200	500	250
6	270	360	450	1,125	375
8	480	640	800	2,000	500
10	750	1,000	1,250	3,125	625
12	1,080	1,440	1,800	4,500	750
14	1,470	1,960	2,450	6,125	875
16	1,920	2,560	3,200	8,000	1,000
18	2,430	3,240	4,050	10,125	1,125
20	3,000	4,000	5,000	12,500	1,250
22	3,630	4,840	6,050	15,125	1,375
24	4,320	5,760	7,200	18,000	1,500
26	5,070	6,760	8,450	21,125	1,625
28	5,880	7,840	9,800	24,500	1,750
30	6,750	9,000	11,250	28,125	1,875

For hoppershaped bottoms the problem of design is more complicated than for vertical walls. The graphical method given by Ketchum for determining pressures and stresses is not difficult to follow. Cain gives four methods for determining the resultant pressure on the inclined bottom of a specified bin. With bin surcharged it varies from 11,400 to 12,400 lb. per lin. ft.; with coal level on top the variation is from 8,100 to 10,100 lb. The vertical forces, however, are so much greater than the forces due to the tendency of the coal to slide that they are the dominating factor. For a number of bottoms inclined 45 deg. and less to the horizontal the writer found that multiplying the weight of the coal by the secant of the angle of inclination and designing the bottoms for this increased amount considered as vertical load gave a close approximation to more theoretical methods. This is equivalent to taking the weight of the coal as acting normal to the inclined bottom.

Bending Moments—The maximum moment for a simple beam of length l and load W distributed so as to vary uniformly from zero at one end to Wl at the other end is $M = 0.128\,Wl$. For the same load W distributed uniformly over the beam $M = \frac{Wl}{8} = 0.125\,Wl$. That is, the triangular loading on vertical beams due to liquid pressure can be assumed to be uniformly distributed with an error of but 3 per cent. If the assumptions of Fig. 3 are made the error is even less.

Grashof's formulas for determining the thickness of flat plates fixed or supported at their edges are given in textbooks. Plates act as catenaries as well as beams and the contents of a bin may act in some degree as arches between beams. In sharp competition, advantage is sometimes taken of these catenary and arch actions in an arbitrary manner, and plate thicknesses are used which, when figured by beam formula, give stresses far beyond allowable limits. Especially is this true of bins filled with heavy material. A recent experience of the writer is to the point. For a proposed ore bin the best that he could do was to estimate the bottom plates $\frac{9}{16}$ in. thick, but the contract was awarded (and presumably the bin was built) on a design with plates $\frac{3}{8}$ in. thick.

In designing flat plates for ordinary coal bins the writer uses the following rules: For square plates riveted or bolted on all four edges the plate is considered a beam with fixed ends (plate held on two sides) loaded with one-half the load. For rectangular panels with the longer axis $1\frac{1}{2}$ times the shorter one the plate is considered a beam spanning in the shorter direction carrying three-fourths the load of the plate, while if the longer axis is two or more times the shorter one the sides are considered to carry the whole load. The distance between supporting beams is considered the shorter axis. Plates often extend over two or more beams but as they are invariably bolted or riveted to each beam they are considered as beams with fixed ends of a length equal to the shorter axis.

A working stress of 20,000 lb. per square inch is used for plates figured as beams.

Lining—Owing to the injurious action of the sulphur and moisture in coal on steel plates it is well to have bins lined. This is usually done with concrete held in various ways. In the 5,000-ton W-shaped bunkers of the Ninety-Sixth St. power station, New York City, there is no exposed steel whatever. Suspension bunkers are often lined with tar or asphalt enamels or mastics.

Where bins are not lined (and there are many such) the calculated plate thickness should be increased. "I always add ⅛ in. for abrasion and ⅛ in. for corrosion," said one engineer. This is not a bad rule to follow. However, bins for bituminous coal may have the abrasion allowance omitted without harm, while on the other hand in coke bins abrasion is specially important.

Details Important—In conclusion, attention is called to the importance of proper detailing in bin work. Bins of the hopper type, with sufficient material, do not always measure up to their supposed strength because of reprehensible details. In one case certain horizontal reactions were neglected and the tension in rivets designed to take shear from vertical loads was all that kept the structure from pulling apart. "Do give us a good detail for attaching a discharge gate to the meeting point of the four inclined plates of a suspended hopper bottom," said an engineer recently. Connections should be detailed in accordance with the stresses they must resist and the proper proportioning of some connections requires engineering ability of as high an order as the proportioning of main members. By no means should a bin or bunker be weakened by poor details.

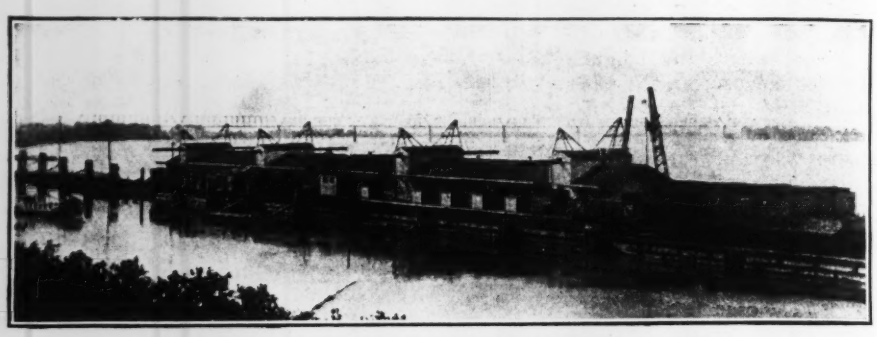
Drainage of Irrigated Lands

Construction of drainage works for irrigated lands represents about 12 per cent of the expenditures from the Reclamation Fund during the past few years, according to figures given by J. L. Burkholder, drainage engineer, in the July number of the *Reclamation Record*, issued by the U. S. Reclamation Service. This work represents an annual expenditure of about $1,000,000 and has aggregated $8,000,000. It includes 889 miles of drainage ditches, 183 miles of pipe drains, several pumping stations, and also the investigations for present and future installations. The work completed is estimated to have reclaimed and protected from seepage about 370,000 acres of irrigable land, and there remain about 125,000 acres which are damaged to some extent by seepage. These drainage works are located on seventeen projects in thirteen states. In addition to the work of the Service, several projects have constructed drainage systems without assistance from the Reclamation Service. Government forces are employed on most of the Service work owing partly to the necessity of making frequent changes as the work progresses and partly to the difficulty of securing contractors who are equipped for economical construction. Ditches are dug mainly by 30- to 90-ton dragline excavators and pipe trenches by trenching machines of the ladder type. During 1921 these machines excavated at a unit field cost of 10.3c. per yard; 6.7c. being for operation and 3.6c. for plant and depreciation cost.

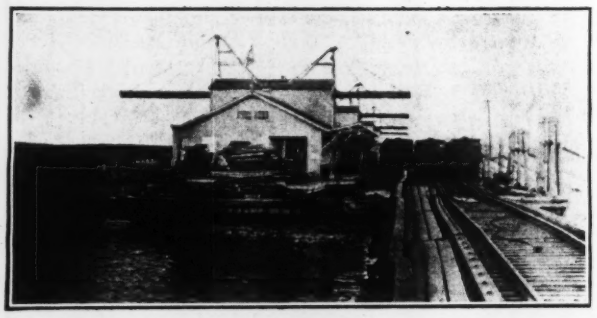
War-Time Concrete Barges Now Used for River Terminal

Large Car-Floats Designed and Used in New York Harbor Transfer in Various Services on Mississippi

DURING the war the government built twelve large reinforced-concrete barges 226 ft. long by 36 ft. wide for car-float service in New York harbor. They were of great service to the military authorities in transferring cars between the railway terminals of New York. After the war one of the barges was sunk while tied up in the Navy Yard at New York, but in the spring of 1920 the eleven others were transferred to the Mississippi-Warrior Federal Barge Line, which operates a fleet of towboats and barges on the Mississippi River between Cairo, St. Louis and New Orleans, and in the Warrior River to Birmingport, Ala. The barges were towed down from New York around Key West to New Orleans by U. S. Shipping Board vessels. Some encountered severe storms but all weathered them successfully. It required 34 days on account of bad weather for one barge to make the trip while ten days is a normal voyage.



CONCRETE CAR-FLOATS ALONGSIDE CONCRETE BARGES MAKE CAIRO RIVER TERMINAL



CARS ON CAR-FLOAT BEING LOADED TO BARGES

At New Orleans the Federal Barge Line built warehouses 200 ft. long by 56 ft. wide, on two of the barges. These with two car-float barges were towed up the Mississippi to Cairo, Ill., where they were fixed by the barge line for terminal purposes. The car-floats were connected together by steel trusses and coupled to the shore by an inclined cradle over which freight cars are carried to and from the floats. The two warehouse barges were placed alongside and secured to the car-floats, as shown in accompanying photographs, furnished by W. H. Tippitt, of Cairo.

Each warehouse is cut by two transverse housings containing cantilever cranes which reach out over the car-float on one side and the river barge on the other.

Accidents to any of the barges do not seriously interfere with the operation of the terminal. Last December a large hole was broken in the track barge connected to the cradle, but this did not stop work or make it necessary to pull the cars from the barge. A bulkhead was built around the hole, the necessary reinforcement was inserted and the hole was filled with concrete. After this was sufficiently hardened the compartment was pumped out and the barge was as good as before.

Use of Sulphuric Acid with Alum in Water Purification

By John R. Baylis
Principal Sanitary Chemist, Water Department, Baltimore, Md.

THE possibility of using acid alum instead of the basic for water purification has been suggested by several authors. Except for recent trials at Baltimore very little has been done towards trying it out. The desirability of keeping the acidity of the water as low as possible, after the application of a coagulant, was thought to be best accomplished by using a basic alum. So universal has become the custom of specifying basic alum, that it is doubtful if any other kind is now manufactured for water purification purposes.

It is shown from data available from many sources, that the optimum pH value for nearly complete precipitation of the alumina in alum, as aluminum hydrate, takes place in a fairly narrow range of pH values. This point has not been definitely established, and the indications are that it varies for different waters. The optimum point for the water now supplied Baltimore seems to be between 5.5 and 6.

Experiments occasionally conducted during the past few years, have, in every instance when the turbidity was low, shown that the addition of a small amount of acid to the water, before, or at the same time as, the alum, has materially aided coagulation. As we thought it best not to increase the acidity of the water, little notice was given the fact until recently. This was due to a change in the character of water treated, caused by an increase in the supply for the City of Baltimore.

This change made necessary the use of considerably more alum than formerly for low turbidities. Experiments were immediately started with a view of finding a more efficient means of properly coagulating the water. Carbonic acid was tried with very encouraging results, in so far as helping form a good coagulation. It has not as yet been possible to try it out on a large scale; that is, to carbonate all the water for a period of a few hours.

Sulphuric acid was next tried with very gratifying results. A number of carefully conducted laboratory experiments indicated such a saving in alum that a few tons of acid were purchased and tried. Several trials have now been made under operating conditions, with results that show a material saving in alum.

The method of conducting these tests has been to mix a certain amount of acid with the alum solution. Amounts varying from 30 to 80 per cent of the amount of alum have been tried, with results indicating that the stronger acid mixtures are more efficient than the weaker.

The test of longest duration was 32 hours, in which time 150.6 m.g. of water were treated. The amount of alum necessary for coagulation without acid would have been at least 15 tons (this being slightly less than what was actually being used at the beginning of the test), costing $450. The amount of chemicals actually used was 7.211 tons of alum costing $216.33, and 10,000 lb. of 66-deg. Bé. sulphuric acid costing $90. To this should be added about $20 for the increased amount of lime necessary for neutralizing the increase in carbonic acid. This made a total cost of $326 compared with $450 if acid had not been used. The average amount of water now treated at the Montebello Filters is approximately 100 m.g.d., so this was a daily saving of about $82. Acid can be purchased under contract cheaper than $18 per ton. Quotations indicate the cost can be reduced about 25 per cent.

The test outlined was made under actual operating conditions, in which the amount of acid added to the alum solution was changed three times in order to test the efficiency of various mixtures. The water at all times indicated an excess of coagulant, filtered perfectly clear, and showed a minimum of residual alumina present in the filtered water.

No attempt to give any of the experimental data obtained in the laboratory will now be made. These experiments enabled us to estimate very closely what to expect under actual operating conditions, and will, when made public, show how closely operating condition can be duplicated in the laboratory.

This announcement is made with the hope of encouraging others to make similar tests. It is not likely that the treatment described will be applicable to all waters but there are many places where its use would effect great economy. Many places that do not care to use acid can with profit specify acid alum, instead of basic, as is now the universal custom. It is believed there are very few conditions where basic alum is best for water purification, except possibly for acid waters.

Propose Engineering Certification of Safety of Buildings

Laws and regulations under which the safety of new buildings would be certified by competent structural engineers are demanded in a resolution of the structural subsection of the New York Section, American Society of Civil Engineers. The resolution, reported by J. B. French is as follows:

Whereas, the recent widespread attention directed to the disastrous theater failures in Washington and Brooklyn makes this an opportune time to emphasize the importance of competent structural engineering in the construction of such buildings; and

Whereas, the responsibility of the structural engineer can only be effective if accompanied by commensurate authority covering both the design and construction of all parts of the building on which safety and stability are dependent; therefore

Be It Resolved, that the New York Section of the American Society of Civil Engineers would be doing a public service and furthering the express objects for which it was organized by exerting its influence for such reforms in building laws and engineering practice as would make it impossible for any building in this metropolitan district where public safety is involved to open its doors to public use until its safety and stability have been certified by a competent structural engineer.

Bolivian State Railway Being Built by Americans

Mountain Line to Connect with Argentine Railways for Atlantic Outlet—American Money, Engineers and Contractors

A 124-MILE railway now under construction in Bolivia is of special interest and importance in that it is being financed and built by an American firm with American engineers and that it will form a connection with the railway system of the Argentine Republic so as to open communication with Atlantic ports. Heavy mountain work is involved. A plan and profile of the line are given in Fig. 1, together with a map showing its relation to the railway system.

An earlier step in American development of railways in Bolivia was made in 1906 when the Bolivian Government arranged with Speyer & Co. and the National City Bank of New York for a bond issue to finance a railway system. At that time there were only two railways: (1) From La Paz, the capital, to Guaqui on Lake Titicaca (El. 12,600) with steamer connection to Puno, Peru, and thus with the Southern Ry. of Peru (standard gage) to the port of Mollendo; (2) the 30-in. line from Oruro to Uyuni, connecting with the Antofagasta & Bolivia Ry. to the Chilean port of Antofagasta. Numerous surveys were made and a line was built from Viacha, near La Paz, to Oruro. But in 1908 the American bankers sold their concessions to the British company which owns the Antofagasta line.

In the general topography of Bolivia a central plateau at an elevation of 12,000 to 13,000 ft. lies between the central and coast ranges of the Andes and extends south into Argentina. Much of this plateau is desert. Lowlands in the eastern section may be developed for agriculture and cattle-raising. But to reach this district from the west coast requires the crossing of the coast range at about 14,000 ft. and the central range at about 16,000 ft., so that the commercial outlet for the lowlands probably will be eastward through the valleys of the Amazon and Parana rivers. Communication with the capital must be provided also, but in view of motor vehicle developments it is thought that a study of this little known region may suggest a highway rather than a railway.

Bolivian Railway System—Three main divisions of the present railway system are as follows (see Fig. 1): (1) The Bolivia Ry., running south from La Paz to Atocha, 390 miles, and now being extended to connect with the Argentine government railways; (2) three western lines connecting with foreign railways to the Pacific ports of Mollendo, Arica and Antofagasta; (3) three railways extending east from the Bolivia Ry.

These three eastern lines are the Yungas Ry., the Cochabamba Ry. and the Potosi-Sucre Ry. The first is intended to reach the headwaters of the Amazon and has 30 miles in operation with about ten miles partly graded, but work is practically suspended. From La Paz the line climbs to El. 15,300 at about Mile 15 with

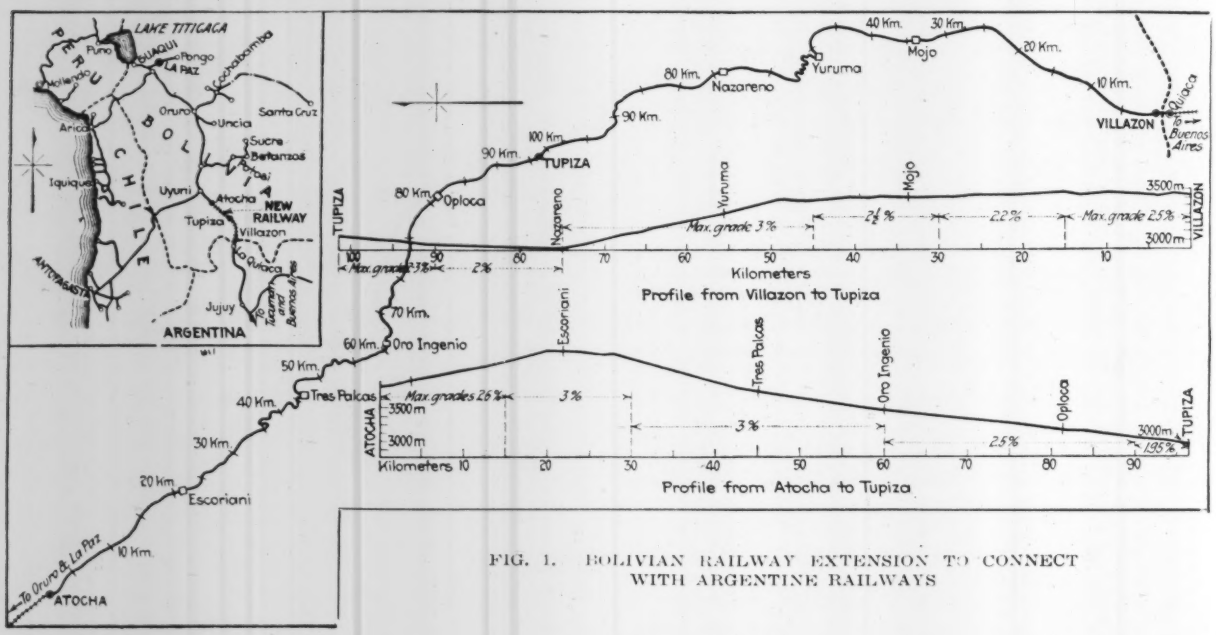


FIG. 1. BOLIVIAN RAILWAY EXTENSION TO CONNECT WITH ARGENTINE RAILWAYS

200-ft. curves and compensated grades of 6 per cent operated by geared locomotives. The Cochabamba line reaches an elevation of 14,000 ft. at Mile 34 and descends the eastern slops with 3 per cent grades and 350-ft. curves. With a sidehill location along steep slopes it is subject to slides and washouts, since the river grade is about 3 per cent. The latest method of protection against washouts is to build heavy masonry blocks, as in Fig. 2, and allow them to settle as the river bed is scoured by floods. The Potosi-Sucre line has its summit elevation of 15,814 ft. at Mile 50. It has 3 per cent grades and 328-ft. curves, but being in firm ground its maintenance gives little trouble. The government is extending the line to Sucre, 150 miles from the Bolivia Ry., and has it in operation for 105 miles to Betanzos with grading partly completed for 20 miles further. This extension, involving heavy work, is under the direction of an American engineer, W. L. Milner, as general manager and chief engineer.

All the Bolivian railways are of meter gage and have maximum grades of 3 per cent, except for 6 per cent on

the Yungas Ry. Curves are generally not less than 328-ft. radius, although 270-ft. curves are sometimes used. Rails are usually 60- to 65-lb. per yard, with 2,420 ties per mile. Steel 110-lb. trough ties are used extensively and there are also California redwood, Douglas fir and Chilean oak. Rolling stock is generally of the American type, but sleeping cars are on the compartment system. Railways which follow the valleys are subject to slides if they cut deeply into the steep slopes and to washouts if they keep near the river bank. Side drainage into the valleys is also a source of trouble, as the whole bed of a ravine, when wet, may move bodily like a glacier and carry away bridges and their foundations. Extensive surface drainage works are necessary to control these conditions.

Atocha-Villazon Railway—The Atocha-Villazon line is the extension of the Bolivia Ry. now being built to connect with the Argentine government railways at La Quiaca. The Bolivia Ry. opened the line from Uyuni to Atocha, 56 miles, in 1913. In the same year a contract was given to a French company to extend the line to Tupiza, but after the grading and masonry had been completed for 30 miles the World War caused the cancellation of the contract. In 1920 a construction cotract was made with Lavenas Poli & Co., Buenos Aires.

In July, 1921, the Ulen Contracting Corp., New York and Chicago, undertook to finance and build the entire line from Atocha to La Quiaca, 124 miles. The original contract provided that the company should take a government bond issue of $7,000,000 and complete the line in five years, carrying out the work at cost and receiving a fixed fee for its services. Later the company agreed to take a $10,000,000 bond issue and to complete the line by July, 1925. Plans based on the preliminary surveys have been approved by the government and final location will be completed early in 1923.

FIG. 2. WALL AND BLOCKS TO PROTECT FILL FROM MOUNTAIN TORRENTS

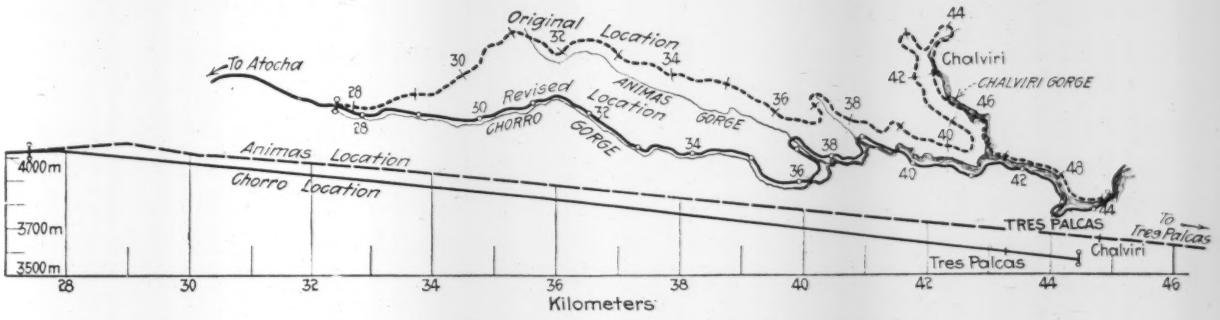


FIG. 3. ALTERNATIVE LOCATIONS IN ROUGH COUNTRY

Leaving Atocha, El. 9,840, the line reaches its summit elevation of 13,307 ft. at about Mile 13 (K.20). Four miles further (K.28) the descent begins on a supported line with 3 per cent grades to Mile 28 (K.46) and down the river to Nazareno, (K.125) El. 9,184 ft. Another supported line with 3 per cent grades then ascends to El. 7,872 at about Mile 93 (K.150) and this general elevation is maintained to La Quiaca (K.200). The Argentine firm is continuing its contract on the La Quiaca-Tupiza section under the direction of the Ulen company and is expected to have track laid by December, 1923. From Atocha the Ulen company is working with its own forces.

Engineering Features—Two principal features of location requiring special study were the 3 per cent line from Mile 17 (K.28 to 45) and the valley line beyond Mile 28 (K.45). Previous surveys for this latter section had followed generally the route along the Animas Quebrada shown by the dotted line in Fig. 3, but careful study indicated the possibility of a shorter line following the Chorro Quebrada. After some difficult field work a practicable line was obtained saving about three miles in distance, 830 deg. of curvature and 96 ft. in summit elevation.

A typical view on the line above Mile 28 (K.45) is shown in Fig. 2. As the subgrade is 130 to 165 ft. above the bed of the stream dry masonry walls at the edge of the roadbed will be used in many places to limit the slopes of fills and thus reduce the excavation. On the valley section, Fig. 4, the steep slopes extend to the river bank. For eight months this stream is dry and its bed serves as a highway, but for the rest of the year it is subject to heavy floods which are apt to be destructive owing to the steep fall of the river. Heavy sidehill cuts are undesirable, since the broken shale formation makes slides probable. In other places the ground is too unstable to permit of benching the

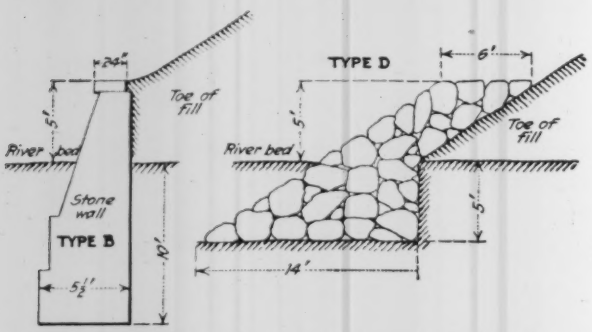


FIG. 4. PROTECTION OF FILL ALONG RIVER BANK

line except at excessive cost and maintenance.

These conditions necessitated a location which in many cases would extend the slopes into the river channel and therefore required the use of protection walls as shown in Fig. 4. The heaviest section, B, is for use where the current strikes directly against the wall. Gravel, sand and boulders, with some silt form the river bed. Floods change the channel continually and show

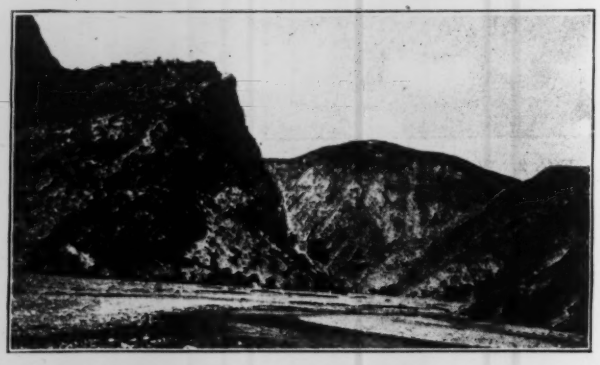


FIG. 5. VALLEY ROUTE FOR HEAVY SIDEHILL LOCATION

differences in elevation of 3 to 5 ft. in a few hours, so that fairly deep foundations are required. Careful work is required in location in order to minimize protective masonry without involving excessive excavation.

The Ulen Contracting Co. has established headquarters at La Paz, with F. T. Hoit as general manager and Major H. R. Gabriel as chief engineer. Most of the location has been in charge of T. M. Whedbee. The general design of the railway, the preliminary plans, contracts with the government and other features have been developed under the direction of F. Lavis, consulting engineer, New York. This article is prepared from data given by Mr. Lavis and the Ulen company.

Sand Cement Analysis

On page 265 of the August 17 issue, *Engineering News-Record*, the analysis of sand cement secured at the Camarasa Project, where the highest dam in Europe is under construction gave the second item $A10_3$ as 54.30, instead of 5.80. The corrected table follows:

SiO_2	54.30
AlO_3	5.80
FeO_3	2.00
CaO	33.20
MgO	0.89
SO_3	1.38
Loss on ig...o	2.43
	100%

Brickwork From Building Stronger Than Laboratory Samples

By Rudolph P. Miller
Consulting Engineer, New York City

THERE is a widespread feeling that laboratory tests on brick masonry have been made on specimens laid up with special care to secure the best results possible or at least with the consciousness that they were to be tested, and that the specimens consequently were better than the brickwork found in ordinary practice. Tests on masonry as actually constructed have not been made or if so have not been reported.

That brickwork having a compressive strength equal to that developed in laboratory tests can be built, and actually is in use, is shown by the results of some tests made by the writer in 1919 in the 400,000-lb. Olsen testing machine at Columbia University.

The specimens used in the tests were taken from the four-story wing of the former home of the Racquet and Tennis Club in West 43rd St., New York City, while that structure was being demolished to make room for a new business building. They came from an interior 8-in. partition wall at a point where it had been enlarged to form a pilaster having a width and thickness of 20 in. For the purpose of the tests the brickwork was cut into four sections, each about 2 ft. in height, and trimmed down to approximately 12 x 16 in. in cross-section, to suit the capacity of the testing machine. Two sides of the specimens were the original finished faces of the pilaster.

There was nothing unusual about the character of this brickwork. It was laid in ordinary English bond, every sixth course a header as called for by the New York building code. The workmanship was good, but apparently no especial care had been taken to produce superior work. The joints were not thoroughly slushed up, and though they were fairly well filled there were voids here and there in which an ordinary lead pencil could be inserted, such as are not uncommon in ordinary good acceptable brickwork. The brick, from the Hudson River district, were sound and well-burnt. According to specifications, corroborated by the superintendent in charge of the work at the time of its original construction in 1903, a 1:3 portland cement mortar was used.

During its life of about 16 years the masonry had carried a comparatively light load, such as would come from a floor used as offices and reception rooms. The load probably never exceeded 100 lb. per sq.in. on the masonry, and perhaps was ordinarily not more than one-fourth of that amount.

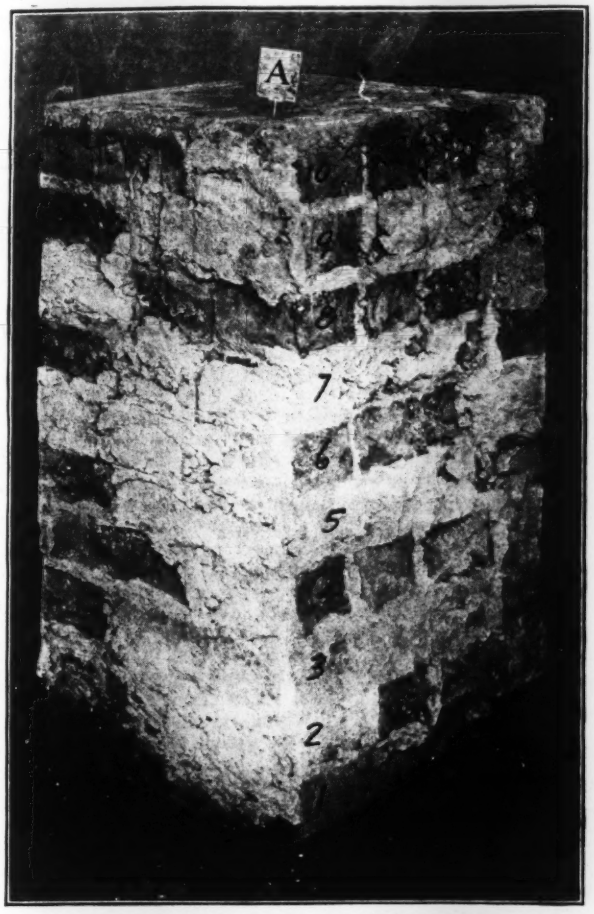
The results obtained in the tests, expressed in pounds per square inch, were:

Specimen	I	A	B	C
Ultimate crushing load	1,389	877	2,093	1,862
Appearance of first crack	516	640	1,588	1,275

The average strength of the four specimens is 1,555 lb. per sq.in. The low value for specimen *A* was due, it is believed, to uneven bearing on the pressure plate of the testing machine, which was not noticed until the initial load had been applied. For comparison, however, it has been retained in figuring the average.

In the table following, the results above are compared with the results of tests made on laboratory specimens. Only such tests are used, however, in which the materials and construction are substantially like

those found in our specimens. Of the Watertown Arsenal series (made at various times since 1884) only those tests are considered in which common brick laid up in 1:3 portland cement mortar was used. Similarly, from the Bureau of Standards series (Pittsburgh, 1917) those cases were selected in which the brickwork was made of Grade 2 brick (common brick) laid in 1:3 portland cement mortar. A series of tests made by Prof. James S. Macgregor at Columbia University



PIER SECTION "A," BEFORE TEST

to determine the proportion of cement in mortar that might be replaced by lime without reducing the strength of the brickwork is also included to the extent to which no diminution of strength was found for common brick. Comparison was also deemed proper with some tests at the Technical High School in Stockholm, Sweden (reported in *The Clay Worker* for July and August, 1917), as the crushing strength of the brick used, 4,040 lb. per sq.in., indicated a brick of about the same quality as used in New York. Of the University of Illinois series (Bulletin No. 27, September, 1908), only two tests appear to be comparable, as shale brick having a crushing strength of over 10,000 lb. per sq.in. were generally used; in the two tests cited, clay bricks having a strength of about 3,900 lb. per sq.in. were used.

The table shows that the average strength of the actual brickwork is about 4 per cent greater than the average strength of the laboratory specimens. And it should be remembered that our specimens had been

TESTS OF ACTUAL BRICKWORK COMPARED WITH LABORATORY TESTS

Series	No. of Specimens	Average Strength, Lb. per Sq.In.	Variation from Average — Highest, Lb. Per Sq.In.	Highest, Per Cent	Lowest, Lb. Per Sq.In.	Lowest, Per Cent
Actual Brickwork	4	1,555	2,093	134.6	877	56.4
Watertown	8	1,705	3,422	200.7	900	52.8
Bureau of Standards	16	1,391	2,070	148.8	700	50.3
University of Illinois	2	1,060	1,090	102.8	1,030	97.2
Macgregor	5	1,337	1,685	126.0	1,170	87.5
Stockholm	4	1,862	1,980	106.3	1,700	91.3
Average of laboratory tests (35 specimens)		1,490				

subjected for many years to actual load, had been subjected to more or less shock in the process of demolition of the building, and had been further punished by transportation to the laboratory and trimming for the testing machine.

Cement Joints for Water Mains

AS A RESULT of experience at Los Angeles with cement joints for water mains, as reported in *Engineering News*, Nov. 25 and Dec. 30, 1915, D. D. Clarke, then engineer of the Water Bureau of Portland, Ore., recommended the trial of cement joints on 1,000 ft. of 8-in. pipe at Portland. This was so successful, says Mr. Clarke in a letter published in the June *Journal* of the New England Water Works Association, that since then, according to F. W. Randlett, successor to Mr. Clarke, cement joints have been used almost exclusively, except where the main must be put in use within 48 hours of the time of calking the cement. Aside from his introductory statements, summarized above, Mr. Clarke's account of the practice and results at Portland is as follows:

The method of preparing the cement and filling the joint adopted here is practically the same as that used in Los Angeles: First quality medium setting cement is used, mixed so dry that the impress of the hand will be left upon a small ball which will crumble when let fall from the height of 12 in. The pipe should be laid upon a firm foundation; the spacing of the spigot in the bell may be effected by placing a small bit of lead under it. A small bit of yarn should be used, just sufficient to keep the cement from entering the pipe. After filling the bell with cement it is thoroughly compacted with a yarning iron, by hand. This will have to be repeated two or three times before the face of the joint can be properly smoothed and rounded.

To the present time there have been laid in this city approximately 27.8 miles of 4- to 16-in. pipe with cement joints besides which about 4,000 ft. of 24- and 30-in. pipe has been relaid with cement joints during the progress of "grade crossing" elimination work.

When the first line of 8-in. pipe was laid in 1916, minute leaks occurred which were entirely taken up in a few weeks time. In relaying the 30-in. pipe mentioned above it was placed in a concrete-lined tunnel which afforded an opportunity of observing the leakage. When the pressure was turned on the 500 or more feet of 30-in. pipe in the tunnel section, the leakage was very considerable. After draining the water from the tunnel two or three times the leakage was noticed to be decreasing and at the end of six months had stopped entirely and all the joints have since remained tight.

At a later date it became necessary to raise 100 ft. of 16-in. pipe which had been laid with cement joints. This pipe was raised approximately 4 ft. under full working pressure of about 70 lb. without any leaks resulting.

Prior to the general use of cement as a jointing material, as indicated above, the department instituted a series of tests to determine the degree of flexibility in the joints of cast-iron pipe when laid with joints of neat cement, leadite or pig lead.

Engineers in Many Fields Discuss Licensing

Extracts from Letters Commenting on the Editorial Discussion of the Subject Published in Engineering News-Record of July 6

Since the publication in the issue of July 6, of an editorial discussion on "A Rational Approach to the Licensing Problem," Engineering News-Record *has invited comment as to the viewpoint therein presented from a number of representative engineers. Some of these were known to favor the licensing principle, some disapproved and others either were neutral or had never expressed any opinions. The replies that have been received indicate a widespread approval of the principles advanced in our discussion, but few of the writers can find valid reasons for the licensing laws that have been enacted and are now contemplated. The following extracts are from some of these replies. Others will appear in an early issue.*—EDITOR.

George E. Stevenson
Civil and Mining Engineer, Scranton, Pa.

Having just read your editorial discussion on the engineers' licensing problem, in the issue of July 6, I take the liberty of congratulating you upon its excellence, and of expressing my own views, especially on the act passed by the legislature in Pennsylvania.

Your queries, "Are the present laws for the protection of the public against such [engineering] failures inadequate? Has state supervision over plans and operations been carried to its maximum usefulness? Does the public safety demand that the state go back of the work itself and certify to the competence of all those who may be called on to plan and execute such works? Will the net results of such a procedure measured in increased public safety justify the labor and expense involved in its administration?"; followed by your statement that "licensing must be justified wholly on the ground of the public welfare and not at all on that of professional advantage," embody all the items that either justify or condemn the principle of licensing professional engineers and land surveyors.

Our present act, "To Regulate the Practice of the Profession of Engineering and of Land Surveying," alleges in Section 1, "that in order to safeguard life, health and property,—etc." In this respect, the act differs from other acts requiring the registration and licensing of those practicing other professions, as for example, medicine. The act of June 3, 1911, is preceded by a preamble, which reads as follows: "Whereas, the safety of the citizens of this Commonwealth is endangered by incompetent physicians and surgeons and due regard to the public health and the preservation of human life demands that none but competent and properly qualified physicians and surgeons shall be permitted to practice their profession. Therefore, etc." The act regarding the practice of optometry of June 30, 1917, contains a preamble as follows: "Whereas, the eyesight of the citizens of this Commonwealth is endangered by incompetent persons practicing optometry, and due regard for the protection and safety of the citizens demands that only authorized and qualified optometrists shall be permitted to practice." The dental act of June 9, 1897, contains a preamble as follows: "Whereas the health and comfort of the public and in many instances the lives of individuals, are contingent upon the intelligent and competent dental service, etc." The act regarding the practice of pharmacy of May 24, 1887, reads as follows: "Whereas, the safety of the public is endangered, etc."

Evidently, the promoters of the engineers' licensing act were not brave enough to make any such false assertion, regarding the practice of land surveying, which is defined in the act "as the determination of area, or the establishment of land boundaries, and the sub-division and plotting of land," or a similar statement with regard to the practice of the professional engineer, who is defined as "one who initiates, investigates, plans and directs the control of the forces of, and the utilization of the materials of nature and human activities in connection therewith for the benefit of man, etc."

In the State of Pennsylvania we now have in force laws which are ample to protect the public and to safeguard the life, health and property of the citizens of the commonwealth, which I believe cover all of the activities of the professional land surveyor and professional engineer that in any way affect the public safety. Pennsylvania Water Supply Commission, Public Service Commission, the State Board of Health, the Bureau of Labor and Industry, the Board of Education, and the State Highway Department, all have power to pass upon the correctness of structural plans covering water supplies, bridges, canals, highways, sewers, factory buildings, buildings arranged for public assemblies, theaters, schools, elevators, steam boilers, etc., and these laws regarding engineering and architectural structures are constantly being remodeled to cover the increased necessities for public protection. Electric power and light companies' construction is supervised, and the crossing of public highways, railroads, etc., by high-tension lines must meet specifications issued by the Public Service Commission and the plans approved by Highway Department or the railroad officials.

Pennsylvania mine laws have been used as a pattern in almost every state where coal is mined, and together with the system of inspection adopted in Pennsylvania, have proved adequate in the main to protect the public and the employees. Whenever experience has dictated more stringent laws they have been immediately passed by the legislature, and plans for structures and the opening of mines must comply with these acts and are subject to the inspection and supervision of the Bureau of Mines.

Why burden the professional engineer and land surveyor, who is engaged in an independent practice, with a registration and license act, under the false claims of protecting the safety and lives of the citizens of the commonwealth, while the engineers employed by the companies engaged in interstate commerce, who plan, build and care for the maintenance of the railroads and bridges, are exempted, and while the selection of the railroad engineers, conductors and signalmen, who operate fast trains over these same railroads and bridges, is left entirely to the judgment of the railroad executives?

Why have the land surveyor registered when we have no standard of qualifications for the motormen and conductors on our street cars, upon whose qualifications and skill the safety and lives of our citizens depend?

Why have the men practicing mechanical engineering registered and licensed on proving their qualifications, when we issue a license to any youth of 16 or over to operate an automobile on a public highway without the slightest attempt to show that the applicants are qualified, or even have any knowledge of the common rules of the road? His acts in operating a motor car are a greater menace to the lives and safety of the citizens of the commonwealth than any blunders of the civil, electrical, mechanical, chemical or mining engineer in independent practice.

I have before me a prospectus of the American Association of Engineers, mailed with the blank application for

membership in the association, from which I quote as follows: "Legislation Concerning Engineers—The Association is primarily responsible for the enactment of laws licensing engineers, thereby protecting competent engineers from the unjust competition of dabblers and quacks, and protecting the public by requiring men who wish to practice as engineers to qualify before a legally constituted board. So far there are 20 states with license laws. Fifteen proposed but did not pass such legislation last year, and in only 13 has any legislation not been initiated. This work must be completed to make the work already accomplished more effective."

I notice in the article by Prof. Harry Tucker, of North Carolina State College of Agriculture and Engineering, advocating the licensing act, that he claims that the most important needs for registration of engineers are, in the following order: 1, for the protection of the qualified engineer; 2, for the protection of the name "engineer"; 3, that the standards of the profession may be raised; (and, apparently in his estimation, last and least) 4, for the protection of the public.

It seems quite evident, as alleged recently in *Mining and Metallurgy*, published by the American Institute of Mining and Metallurgical Engineers, that the professional engineers and land surveyors of the United States have been asleep and have permitted a small minority to put across these iniquitous licensing acts, which even on the showing of their advocates hold the protection of the public as a consideration secondary to the interests of the professional engineer who fears competition and desires to exclude it. The real engineer welcomes competition always, especially from the quacks and dabblers, for such competition invariably enables him to extend his field and increase his fee.

It may interest you to know that some of us in Pennsylvania are awake to the situation and are contesting the constitutionality of the act, which among other things, provides "that no man shall practice land surveying or professional engineering as an independent practitioner until he is 25 years of age." How in the world they can ever justify the licensing of land surveyors on the theory that it is for the protection of the lives and safety of the people of the commonwealth is inconceivable. A test case following the arrest of a practicing land surveyor is now under way in Pennsylvania. If this is unsuccessful, we propose to go to the next legislature and work hard for the repeal of the present act and if possible to prevent the passage of a future act. To that end we solicit the assistance of all those who are interested against this selfish licensing scheme.

* * *

T. J. Wasser

President, State Board of Professional Engineers and Land Surveyors, Jersey City, N. J.

Your editorial on "A Rational Approach to the Licensing Problem" in the issue of July 6, 1922, was discussed at a meeting of the State Board of Professional Engineers and Land Surveyors, and it was found that each and every member of the board had previously read it. We feel gratified to know that the conclusions reached by you coincided exactly with those reached by our board and previously adopted.

Particular attention is called to your second principle. The board is unanimous in the opinion that the license must actually define the kind of engineering work followed by the licensee. This is not very clear in the law, but legal opinion justifies the board in reaching its conclusions. This is fully covered by Rule No. 8, which has been adopted by the board and which reads as follows:

Branch of Professional Engineering. In making application for license as a professional engineer, applicant must state clearly which division of professional engineering to which applicant belongs, as for instance, "Civil, Mechanical, Electrical, Mining or Chemical Engineer."

If applicant belongs to the division "Civil Engineering," state clearly the sub-division in which applicant is qualified, as for instance, "Railroad Engineer, Municipal Engineer, Sanitary Engineer, Highway Engineer," etc.

This rule is for the benefit of applicant who has specialized in one of many sub-divisions of civil engineering, and the Board reserves the right in issuing licenses as a civil engineer or for any of its sub-divisions, to use its discretion as provided for in the act.

The board feels justified in proceeding in this method and is pleased to know that its judgment was so ably seconded by your article.

* * *

F. M. Randlett

Engineer, Bureau of Water-Works, Portland, Ore.

Your editorial discussion, entitled "A Rational Approach to the Licensing Problem," seems to me to be a very fair one and I think you are to be congratulated on not having written to curry favor with the licensing enthusiasts. It is a pity that a slightly more dignified word could not have been used; one that would have tended to raise instead of lower the profession in the eyes of the general public. The lawyer is admitted to the bar and the doctor passes the state board examination, while the engineer takes out his license.

In Oregon the statute has been in force about three years and discussion for and against it has been going on with the enthusiasm shown more by those in favor of the law than by the opposition. The opponents seem to have rather quietly acquiesced, paid their fees and gone their way. The public, as such, has so far failed to express any opinion. Whether or not the public has been benefitted is hard to say, but it may be safely stated that it is probably apathetic as to whether the engineer is licensed or not.

The companies or corporations requiring engineering service are apparently able to protect themselves from the unqualified seeking to sell their services and evidently employ fairly good talent. Possibly some of the smaller towns and cities have been imposed upon, but usually due to the fact that they accept the proposal of the lowest fee and consequently get about what they pay for, with the usual results. When it comes to hiring an engineer for state or municipal purposes the fact that the candidates are licensed does not insure the employment of the proper man. The public, therefore, is not necessarily protected, and as a licensed engineer only may be appointed, the effect of the law is purely class legislation.

There is no distinct line whereby we may know when the engineer ceases to be an engineer and becomes an executive, except as indicated by the title of his position, which often is not indicative of his duties. A manager or superintendent may function as the engineer and the engineer may be executive only. In such instances who shall be licensed to protect the public?

I quite agree with your summary and closing paragraph, except that I sometimes think "the avowed purpose of its advocates" is possibly a blind for the class legislation it is hoped will prevail.

* * *

A. L. Dabney

Consulting Engineer, Chairman Tennessee State Board of Architectural and Engineering Examiners, Memphis, Tenn.

The editorial discussion in your issue of July 6 correctly presents the principles on which license laws for engineers should be based. Unquestionably the only consideration with legislators must be: Does the public interest demand such laws? One who has reviewed many applications for license in a state that has recently adopted the licensing of engineers must concede that it does.

It is true that many employers of engineers have the ability and means to find men of whose competence there is no doubt; but the clientele of many engineers is largely represented by boards of laymen (city and county officials and others) who do not devote the necessary time and thought to investigating the engineer's qualifications. The recently enacted law in this state recognizes that only those engineers who are responsible for results, and not their subordinates, should be licensed.

The writer is fully convinced that the public interest

demands that engineers be licensed, and that the interests of the profession demand it; and while the legislature can consider only the public interest, the profession may properly avail itself of this method of improving its status before the public. The analogy of the engineer's case to that of the doctor and lawyer should, of course, be viewed with proper allowances. It may be suggested that while members of the medical and legal professions have more frequently a clientele of individual citizens, it is largely among neighbors and acquaintances of long standing. Their field is geographically small and does not change much. The engineer must frequently find his clientele among persons who have never seen him before, and probably never before had occasion to employ an engineer. As a result, a young man with ambition and nerve but little technical ability, is frequently employed for important work and takes up his abode in a community that has theretofore given little thought to what an engineer is. He becomes that community's conception of an engineer; and an appreciable part of the population of this country regards the engineer not as a member of one of the learned professions, but as one of a class of persons resembling their new fellow-townsman.

When the licensing of engineers has become general and the standards for granting licenses are raised to a proper level, our profession will be, in the estimate of our fellow men, on a much higher plane than it now occupies.

To attempt to define, by a license certificate, precise bounds within which the licensee must confine himself, would be a difficult task. Might we not hope that as the standard is raised through succeeding years, the time will come when no engineer may be licensed who is not substantially grounded in the underlying principles of all engineering knowledge? Then, although the licensee may pursue a special branch of engineering, he would not be ignorant of all other branches; and his standards would not permit his undertaking work for which he knew himself to be indifferently qualified. How many engineers have any of us known, of real standing in the profession, who would undertake work for which they were not qualified? License laws, properly framed and enforced, should ultimately bring all practising engineers to this standard by eliminating those who cannot be brought to it. Again resorting to analogy: a physician's license does not attempt to define his specialty.

After assisting in the drafting of a law and then trying to recognize it, after various committees have modified it, one decides that at present theory and practice in this matter are still far apart. Reassurance lies in the thought that if a state legislature recognizes, by the passage of any bill, however weak, that the public interest demands licensing of engineers, the details of the bill are of little moment. They can be gradually improved as the state becomes accustomed to the license idea.

* * *

F. G. Jonah

Chief Engineer, St. Louis-San Francisco Ry., St. Louis, Mo.

I personally have always been opposed to the licensing of engineers, first, because it does not add anything to the competency or qualifications of the men possessing the licenses, and consequently does not make for increased ability in the profession, nor does it in any way give the public any better service than it now receives.

I am opposed to it because it means one more governmental regulating body in each state, and we are cursed with these now, nationally and locally. What it means is a machine for examinations set up by some board in each state, who we know in some instances are using their offices to make engineering a closed corporation and keep out the outsiders; and these examining boards are politically appointed and paid by the state.

If, however, any state is bent upon putting a license bill through, then I think the best thing we can do is to have a uniform law that has already been adopted in several of the states.

Hugh L. Cooper

Consulting Engineer, New York.

I think the six principles that you have laid down at the end of your discussion of this licensing subject are all of them at least steps in the right direction. While the liicensing of engineers is a very great question, it is a question that should be met and decided squarely on its merits and just why engineers should not be licensed on their merits is something I have never been able to understand.

A good many thousands of lives and a good many millions of dollars would have been saved in the past if the public were honestly informed through some legitimate licensing system or some other good fountain of intelligence as to the qualification of the engineer for the work he was attempting to do.

* * *

Allen Hazen

Consulting Engineer, New York.

The editorial discussing licensing, which appeared in your issue of July 6, is, I think, the most comprehensive and fair statement in regard to the subject that I have seen. I have been one of the consistent objectors to licensing from the beginning and up to the present I have seen no good reason for changing my point of view. In other words I have been unable to see any advantages either to the profession or to the public to compensate us for the very considerable trouble and expense to which we are put in connection with licensing.

Any firm of engineers employing a considerable staff must be in danger of violating state laws more or less frequently in its ordinary professional practice. However many licenses it may take out, it hardly seems feasible to apply for licenses in every state that passes such a law for everyone of its men, and the problems that come up usually require prompt action.

Engineering practice is not limited by state lines and in my judgment it would be very unfortunate to have any such limits drawn. If licensing is to become a permanent system a much greater degree of reciprocity between states would seem desirable and almost necessary.

* * *

C. J. Tilden

Professor of Engineering Mechanics, Sheffield Scientific School, Yale University, New Haven, Conn.

I have read the editorial carefully and with much interest. It seems to me that you have put the case well and I find myself substantially in agreement with what you say. I do not believe, however, that we can dismiss the matter by saying that licensing is not worth while. As in so many other cases, we are confronted by "a condition instead of a theory." Many states have already adopted license laws and others will undoubtedly do so. What we should do, therefore, is to guide the lawmakers, so that the resulting legislation will do the least possible harm and, if possible, some good. I have in mind particularly the recent law enacted in Pennsylvania, which seems to me a complicated, cumbrous piece of machinery, causing unnecessary irritation.

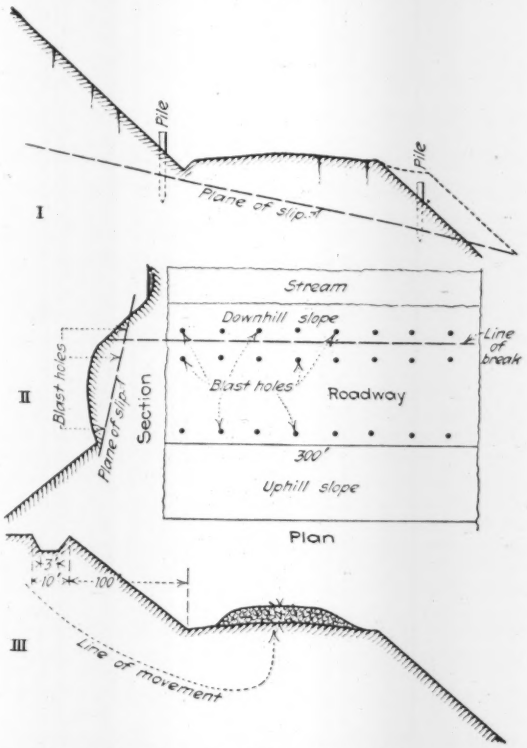
We should recognize frankly, as you say, that no law can fully protect the public from incompetence. The claim put forward at the time of the Knickerbocker disaster was absurd. The law should provide hardly more than an authorized list of engineers practicing in the state. The requirements of the law should be as simple as possible and the expense of registration merely nominal. The qualifications specified should be *minimum* and not an elaborate list of the desirable qualities in a trained engineer. It should be distinctly stated that the state assumes no responsibility in the matter and gives no assurance of safety to the public.

I congratulate you on the editorial. A clear and impartial statement of this sort will help greatly in clearing the atmosphere.

Methods of Overcoming Slides on Side Hill Roads

Inclined Rock, Shale or Clay Stratum Usual Cause —Relocation Often Only Remedy—Each Slide a Different Problem

LATERAL slides have made maintenance a troublesome task on side hill highways in Ohio. Within a few years several hundred slides have required cognizance by the state maintenance forces and some of them have called for expensive remedial measures. Usually each occurrence has required separate treatment but a number of methods have been satisfactory enough in several different instances to establish themselves as good practice. They are ditching to remove water and stabilize the soil; driving piles to lock together the sliding layers; and a subsurface blasting to roughen the rock surface and thus keep the overburden from sliding.



TYPES OF SIDE HILL SLIDES AND REPAIR-METHODS

All three methods, as carried out in special instances, are illustrated by the accompanying sketches.

Ordinarily slides have occurred when a shale, or a clay or a rock layer, inclined downhill, provided a sliding plane. On this sliding plane the overburden was disturbed sufficiently by the cutting to permit water and gravitation to overcome a previous state of equilibrium. It is noted among the observations of these Ohio slides that a hill-slope of fragmentary material on an inclined solid stratum of any material impervious to water is often made unstable by a very slight removal of material particularly in the form of a continuous gash like a highway cutting. Commonly, earth movement does not at once follow and this, with the always pressing need of keeping down the cost, has led to taking a chance in locating the road and in not opening back the uphill slope and buttressing the downhill slope with an ample fill. In some instances, as stated, no practicable amount or character of cutting would prevent movement. Relocation is the only resort.

Where the stratum on which the slide traveled, as shown by Diagram I, is shale or clay penetrable by piles, considerable success in holding the moving earth has been had from driving two rows of piles as indicated. The piles spaced about 10 ft. apart, practically nailing together the moving and the stationary strata, were enough of an obstacle to check movement.

In the second diagram, where the sliding plane was rock, sliding was stopped by roughening the ledge surface to increase the friction. Holes were drilled through the overburden and into the rock and light blasts were fired. These blasts broke and heaved up the ledge surface making it sufficiently rough and irregular to retard the slide.

A more common remedy is to ditch the uphill crest as shown by diagram III. In this instance the earth movement had heaved up the road surface without much lateral movement. By ditching along the uphill crest and leading the surface water right and left along the road the slipping was checked.

Erection Record on a Chicago Building

ERECTION of 7,500 tons of steel in 70 working days with two derricks and a crew averaging 90 men was the record for the frame of the first section of the Illinois Merchants Bank Building, Chicago, which was completed June 17. The crew worked an 8-hour shift daily for 5½ days each week. Fig. 1 shows the record flag hoisted over the erecting gang of 24 men. Fig. 2

FIG. 1. STEEL ERECTION GANG WITH RECORD FLAG

shows the work partly completed with the two derricks in position.

This 21-story building will be 316 x 178 ft., but is being built in two duplicate sections, the first of which will be finished and occupied before the old three-story bank building on the adjacent site is torn down. This old building is shown at the left in Fig. 2. Thus the total amount of steel will be about 15,000 tons. In the present section, approximately 167 x 178 ft., there are

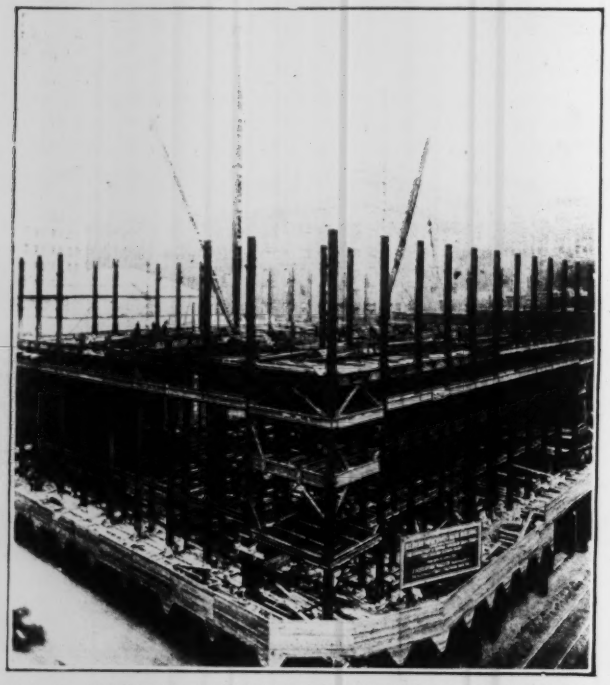


FIG. 2. ILLINOIS MERCHANTS BANK BUILDING, CHICAGO

two sub-basements, basement, mezzanine floor, nineteen regular floors, attic and roof.

Two steel guyed derricks did all the erection, placing the steel for two floors at each setting and averaging 4½ days for the two stories. Each derrick had a 112-ft. mast, 100-ft. boom and 100-hp. electric motor. They worked as independent units, each derrick raising itself to the new level at each setting. The heaviest members handled were two-story columns weighing 24 tons. A maximum record was made of 320 tons placed in one day.

This erection work was done by the Overland Construction Co., Chicago, the steel being fabricated by the American Bridge Co. The Henry Ericsson Co. has the general contract and Graham, Anderson, Probst & White are the architects.

St. Paul Water Consumption

The water consumption in the City of St. Paul during the year 1921 was 83.2 gal. per inhabitant, and 416 gal. per day per tap. The taps are 96.5 per cent metered but only 68.3 per cent of the total consumption is metered. The average quantity per day passing each meter is 321 gal. The cost of supplying water per million gallons figured on the total maintenance charge is $44.73, but figured on total maintenance plus interest on bonds and sinking fund it is $73.51. St. Paul supplies only about 60 per cent of the total water consumed within its limits.

Comprehensive Program for Denver Water-Works System

Single Control of South Platte Water and Use of Marston Lake as Terminal Reservoir Recommended—64-M.G.D. Filters

UNIFIED control of all the water of the South Platte River above Denver under the management of the city and a gradual concentration of all the supplies through a new set of conduits leading to and from Marston Lake as a distribution reservoir where all water would pass rapid filters, are the main recommendations in the report of the Engineering Board of Review recently submitted to the Water Commissioners of Denver, Colo. Immediate construction to increase the present supply by 60 per cent at a cost of $6,700,000 is advised. The principal items are as follows: New conduits, $3,037,000; 64-m.g.d. filter plant, $1,250,000; distribution mains, $1,955,000; pumping station improvements, $334,000.

The Board of Review, consisting of Dabney H. Maury of Chicago, H. T. Cory of Los Angeles and H. S. Crocker of Denver, was appointed at the suggestion of the Denver Civic and Commercial Association after a $5,000,000 bond issue for certain improvements failed of passage at an election held on May 17, 1921. A committee of prominent local engineers from the association nominated a list of engineers from which the members of the Board of Review were chosen by the water-works officials. The board of Review has been at work since February. Its main conclusions and recommendations, leading to an ultimate supply of 200,000,000 gal. a day, are:

The health of the citizens must be safeguarded by insuring the quality of the water used by them. This result can only be obtained by aeration and more complete filtration than the existing plant affords. About half of the water consumed annually is adequately filtered, the remainder being sterilized by chemical processes. Sufficient pressure for fire protection can only be provided by increasing the size of street mains and by making extensive additions to the distributing system in the business district as well as in the other portions of the city where low pressures exist. Extensive areas in scattered sections of the city have insufficient supply and pressure for household purposes and lawn irrigation.

Water is brought to the city from Platte Canyon through a complicated system of wood-stave pipe lines which are in various stages of decay. One or more of them may fail at any time and the excessive cost of their repair is becoming too great to be borne by an intelligent community. The failure of even one of these pipe lines during the period of greatest consumption would seriously impair the supply. The immediate imperative need is the construction of a new and dependable conduit system. It is recommended that a permanent aqueduct be built from Kassler (mouth of Platte Canyon) to Marston Lake of sufficient ultimate capacity to serve the future requirements of the city.

The water rights of the city are involved with the irrigation rights of others. The lands about Denver are, except for a relatively small acreage with the earliest water rights, unsatisfactorily irrigated. The real water requirements of the lands around Denver are almost exactly the same as of these lands when put to urban uses. Thus by providing ample irrigation water for its environs, Denver automatically provides water for its practically unlimited growth. To provide an economical and satisfactory administration the proper legal steps should be taken by the city for a unified control of the South Platte watershed above Kassler, thus insuring the greatest beneficial use of the stream. The City of Denver seems to be the only feasible agency. The purchase by the city of the Antero Reservoir

and High Line Canal is recommended as part of this general plan.

The supply available from the eastern slope is inadequate for the future Denver. Provision should be made at once to secure a perpetual right to all possible diversion from the western slope. It is conservatively estimated that 250,000 acre-ft. [81.5 billion gallons or 225 m.g.d.—EDITOR] may be obtained from that source.

The city is facing a water shortage, and an adequate supply of water and proper water service are as vital to Denver's life as food is to any one of her citizens. Denver has a larger population and a greater assessed valuation than had Los Angeles when it embarked on the installation of the $30,000,000 Los Angeles Aqueduct. [Population of Denver, 256,491 in 1920; 213,381 in 1910; 133,859 in 1900. Population of Los Angeles: 576,673; 319,198; 102,479. The Los Angeles Aqueduct was projected in 1904-5.—EDITOR.]

A great deal of electric power can be generated as a byproduct of the comprehensive development of water conservancy outlined in this report. The total installed capacity of all practicable plants will ultimately exceed 100,000 kw., and although most of them may run but part time, the total annual output will exceed Denver's probable consumption for a long time to come.

In explanation of the concentration of the supplies in Marston Lake and the decision to eliminate ultimately the slow sand plant at Platte Canyon and the present sites of galleries and rapid filters the report states:

The small sources of supply at the Mississippi Street and Cherry Creek galleries are the residues of an endeavor to provide water for a small population.

The establishment of Platte Canyon as the principal point of diversion and purification, and the carrying of treated water thence, was the result of endeavoring to bring mountain water to a relatively small unit (96,000 population) in the face of an intrenched, existing supply, and before any really promising reservoir site on the watershed above had been located.

The almost ideal terminal raw water storage for a very large mountain supply, Marston Lake, was developed not so much for that purpose as to render Bear Creek an available source of supply. Because of its size it is impractical to cover it, and without such covering algae growths develop, especially during the summer months. As such growths are much more abundant in clear water than in turbid water, Marston Lake is not well adapted to the storage of clear water, filtered and ready for immediate consumption.

Notwithstanding the large amount of distant storage in Lake Cheesman, the major portion of the pure water supply to the city is now dependent on conduits carrying water 23 miles to terminal storages in the city holding altogether but little more than a single average day's consumption.

It is necessary to shift, as gradually and economically as possible, from the existing arrangement to a plan whereby the terminal storage of raw water will be at Marston Lake, practically on the outskirts of the city, with all aeration and filtration works located on the city side of that storage, and with several conduits leading thence to the filtered water reservoirs within the city proper.

In support of the recommendation to consolidate control of the South Platte water for domestic purposes and irrigation the report states that about 100,000 to 150,000 acres near Denver are poorly irrigated. Control has not been uniformly satisfactory and will not be unless some agency outside of land owners takes the initiative. All signs point to Denver as the agency. Storage, seepage and exchange of unregulated water in one place for regulated water in another place are the three points necessary to regulate the supply. Ultimately, power as a byproduct only will be developed.

Discussing terminal storage in relation to fire losses the report states that since conduits which bring water from distant sources cannot be made failure-proof, sufficient capacity should be provided to meet the city's demands for a period as great as the time required to repair any possible damage. Taking 200 m.g.d. as the ultimate draft, Marston Lake provides 30 days' storage. The construction of a 225-m.g.d. conduit, 12½ per cent in excess of 200 m.g.d., to carry raw water from Kassler at the mouth of Platte Canyon to Marston Lake, is advised as the lake could be refilled in eight months.

Ample mountain storage opportunities exist in the South Platte for the entire region. Data on fourteen reservoir sites having capacities aggregating 1,154,000 acre-ft. are given. The cost varies from $16 to $135 per acre-ft. capacity.

For trans-mountain diversion from an area within 60 miles of Denver along the western rim of the Continental Divide, three tunnels aggregating 14.6 miles long are contemplated to bring water from the Blue, Williams Fork and the Fraser Rivers. Two of the tunnels would carry 1,200 sec.-ft. and the third, 1,000 sec.-ft. Diversions from the Fraser to Boulder Creek through the pilot tunnel of the Moffat Railroad would be exchanged with owners of irrigation rights below Denver.

Purchase of the Antero Reservoir and the High Line Canal was recommended as one of the first steps toward Denver obtaining control of the situation, although as to the legality and wisdom of the contract to purchase these properties by the old Public Utility Commission the Board of Review stated it did not feel qualified to express an opinion. Litigation is still pending on the contract to buy.

Meters are not recommended. As stated in discussing a reduction of wastes on certain water-logged hay lands, Denver at the present time is more concerned in demonstrating the greatest beneficial use of water than in reducing wastes or inefficient uses to a minimum. Other reasons given are as follows:

At least 80 per cent of Denver's supply comes to the consumer by gravity, so that the cost of pumping the water would be only slightly reduced. The cost of filtration would be reduced almost, but not quite, in proportion to the amount of water saved by the meters. The capacity of the first installment of the permanent plant should under no circumstances be made less than that herein recommended, so that no fixed charges could be saved at this time.

To meter all of the services in Denver would cost about $1,250,000 and would entail an added annual expense for reading and testing and for making out and collecting meter bills. There is a strong local prejudice against meters.

The present meter rates in Denver are inequitable and are far from being such as would tend to make meters efficient in preventing waste. Incidentally, the Denver meter rates are much lower than those in many cities located in places where water is more plentiful and close at hand. The fact that Denver is located in an arid region and has to bring its supply from an unusually long distance greatly increases the cost of furnishing water, but this fact is not reflected in its meter rates.

When meters are installed in Denver, as they surely will be at some time when their installation would postpone a large expense for new construction, an entirely new schedule of meter rates will be essential.

Aeration to eliminate tastes and odors is liberally provided for in the filter plant design. It is proposed to build sixteen 4-m.g.d. filters having a nominal filtration rate of 150 m.g.d. per acre, filtration to be preceded by 3½-hours' sedimentation after coagulation. An experimental filter plant is recommended to ascertain how much aeration is necessary and what type of aeration is most effective in removing tastes and odors.

Emphasis in Education Shifted to Research Work

Defines New Educational Objective, and Pictures Ideal University as Clearing House of Knowledge for Public Service

IN DISCUSSING the evolution of educational ideals and purposes at the fifty-first commencement of the University of Illinois, last June, Dean Eugene Davenport, of the College of Agriculture of that institution announced a shift in the educational objective. His views are covered in these extracts from his address:

Now, the most significant feature of this evolution in education is not the agricultural college, the engineering college, or even vocational education. It is the shift in the objective and the consequent change in the essential features of university outlook and activity. Traditionally, the objective in education had been almost exclusively personal; namely, to endow certain favored individuals with a mental equipment which should set them apart as members of a privileged class distinguished for culture or aptitude for government, or other leadership, in any event freed from the ordinary problems that plague humanity.

But now the objective is *life;* how to understand it and how best to live it for the common good. So has the scene shifted from the man to his activity. So have language, literature, and history; agriculture, engineering, and economics; the natural sciences and their applications; philosophy and art in all its forms—these and their relations to mankind have become objects of study as means of understanding life and of living it more successfully rather than as means of educating individual men and women for their personal advantage over others. This means that today the student has become the means to the end, like a good book, rather than the end itself; and this is well.

Research Fundamental—Incidentally this change in objective from the man to the activity has radically altered many of our fundamentals in procedure. For one thing, it has shifted the emphasis from instruction to research. So long as the only objective was the education of the individual, we were inclined to satisfy ourselves with that which chanced to lie at hand, and discovery of new truth was left for the few solitary souls who may be called educational pioneers by nature.

But when the chief objective becomes the development of this, that or the other field of knowledge, then the faculty of an institution becomes a body of real scholars who will exert all their powers toward discovering new facts and setting them into their proper places with related facts in order that principles may be brought to light and safe procedure indicated. Where this great process of critical analysis and synthesis, with logical deduction which we call research, is going on, the student catches the spirit almost out of the atmosphere, and instruction becomes incidental to that kind and that thoroughness of inquiry after new truth which seeks to learn all the facts with which life and its activities must reckon.

It is this shift from instruction to research that has brought the university into new relations to the public. Farmers, for example, ignored the agricultural college for thirty years, but they did not ignore the experiment station. They said they wanted facts, not theory. They got them out of the experiment station and so did the student, and what has been done in this newest of all educational attempts is being done, or will be done, for every essential activity of the people of the commonwealth. As the support of the farmer has come to rest upon what scientific study could do for the business and life of farming, so will the university as a whole be supported both morally and financially in proportion to what the public believes the institution will contribute to the common welfare.

All this, declares Dean Davenport, means that the faculties of the state universities must take their cues from the broad problems that puzzle the people, and seek to aid in solving them. He continues:

For all these reasons our state universities are coming to be regarded as repositories of knowledge needful to the people, and the dwelling places of prophets who have some peculiar insight into the future, because knowing the present and the past with a relatively disinterested perspective, they may speak as one having some authority.

The world needs and wants and will have, if we permit it, the closest possible contact with such repositories of knowledge and such sources of prophetic wisdom. We are honored today by the visit in a body of the first citizens' organization to officially undertake, as they did some quarter of a century ago, the moral and financial support of an essential part of the work of a state university. I refer to the Illinois Farmers' Institute. Their example has been followed and will be further followed as the years go by. For it is because the world believes in the value of such sources of information that the states have endowed these institutions beyond the dreams of a half century ago and will still further endow them in proportion as their present hopes are realized and all our eyes are still further opened.

After pointing out the benefits of the co-operation that have existed between the citizens of Illinois and its university, and after urging a resumption by the state of the ten-year program for "a biennial investment of $10,500,000, in the discovery and promulgation of knowledge and its application in the State of Illinois," Dean Davenport declared that:

We hear too much about educating for leadership. What the world wants is not leaders, of whom it has a surfeit, but rather information and trained habits of thinking that it may select its leaders wisely. This all means the closest possible working relations between the institution and the citizenship of the state; between those who, feeling the pressure of unsolved problems, realize the need of better information, and those whose business it is to supply the need. A university so guided will remain close to the people and close to its problems. A university that so functions will not come very far from fulfilling its highest usefulness, and a university so favored will not, in the long run, want for support, though its normal condition will be one of poverty because the load will always come before the relief.

Such university has no special schemes to promote, no propaganda to "put over." It is a public service institution, serving the world in every way possible at all times and places where knowledge is needed, drawing upon that world in turn for all it is able to contribute to public welfare through the medium of its everyday experiences. Such a university is a clearing house of knowledge, both old and new—free to all who need it for the public good.

Effect of Dyes on Protozoa in Sewage

The British Minister of Health, Sir A. Mond, was recently asked during question hour in the House of Commons whether his attention had been called, according to London *Municipal Engineering and the Sanitary Record*, "to the discovery by Thomas H. Fairbrother and Dr. Arnold Renshaw, of Manchester, England, of several dyes, which, in the activated-sludge process of sewage purification, can kill the devouring protozoa without harming the purifying bacteria; and whether he would give facilities for carrying out the results of this highly important piece of laboratory research work." To this the minister replied that the matter had been brought to his attention but that he was "advised that further research work would be needed in order to test the application of this and other discoveries to the activated-sludge process of sewage purification, and he was making inquiries as to the best means of facilitating the necessary investigation."

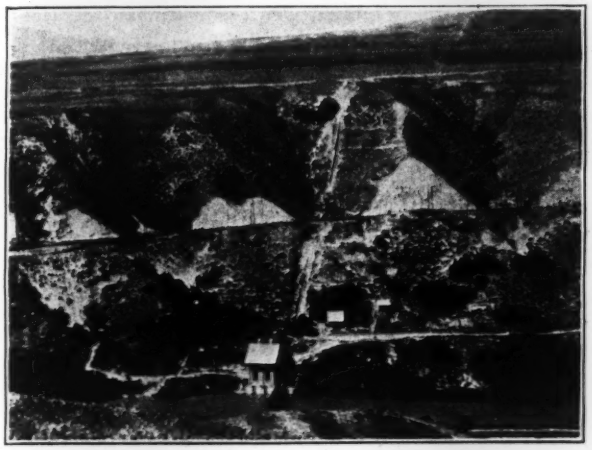
Notes From The Intermountain Country

By W. W. DeBerard
Western Editor, *Engineering News-Record*

Engineering in Utah—Ogden and Salt Lake

ENGINEERS have followed the example of the prevailing religious faith in Utah in that they have learned well the lesson and advantages of organization for efficiency. Perhaps nowhere else in the country does the engineering profession count for more in a truly helpful civic way than in Ogden. Shoulder to shoulder with the business clubs is found the engineer and his organization. He gets on all general civic betterment committees and when he does anything he gets into the newspapers. In a broad way he is here carrying out what the recently issued book on "Publicity Methods for Engineers" advocates—do something and then tell about it. Co-operative effort in public affairs, however, does not mean uniform accord on engineering subjects. In a comparatively new country where there are so many problems, debate is strenuous.

While debate proceeded, for example, on the maximum lift feasible for an irrigation project, Ora McDermitt built and is now operating one successfully beyond the limits under consideration—the Bonneville Project with 150 and 300-ft. lifts. However, all projects are not in 6-acre tracts and do not have markets developed so



HIGH HEAD PUMPING PLANT FOR IRRIGATION WATER AT THE NARROWS

close to Salt Lake as has this one. At another project at the Narrows a lift of 175 ft. is employed for late irrigation. This is shown in the accompanying view.

Two other examples may be cited. Smoke haze hangs over the eastern and better residence portion of Salt Lake in the winter time due to this area being in an air eddy created by a down draft through City Creek Canyon. Shall a large sign board air deflector be built to direct the air current so as to sweep away the smoke or is the only way to avoid the nuisance improvements in firing methods and the use of smokeless fuel such as coke or gas? Both fuels ultimately will be available for all conditions are favorable to their production at a low figure.

Like El Paso, torrential storms occasionally flood sections of the city that need a storm drain because of the very steep slope on which most of the city has been built. These storms lodge debris on certain paved and unpaved streets for miles at a stretch. Undue washing is being prevented by constructing curbs and gutters long before pavement can be afforded, the roadway being given a high crown to deflect the water into the gutter, and oiled to prevent erosion.

An effective campaign for funds for a storm sewer must be waged for property owners are well fed up on high taxes. A heavy storm occurred during my visit causing damage exceeding twice the annual interest charge on the proposed improvement ($850,000). This storm was taken advantage of by the city officials to educate the public in the newspapers to these facts. S. Q. Cannon, city engineer, says that bond issues are usually voted upon favorably in Salt Lake if the people understand what the money is to be spent for and the utility of the finished project. If they do not understand or there is much technical debate the people take the view that the engineers must first be sold on the proposition and be in favor of it. Lack of education in an election authorizing bonds for water-works extensions last year defeated the issue.

Salt Lake Water Department—In the water-works office H. K. Burton, superintendent, has problems winter and summer, noted often in these columns; but a new one developed last winter following a 120-in. snowfall at Lakes Phoebe and Mary. Due to a wrecked 'phone line an attendant left on the job to make observations and handle the gates did not report for five days. After the third day snowshoe parties were started from the city to effect his rescue. Mr. Burton is now considering the installation of a radio outfit.

The scenery at the head waters of the city's supply is unsurpassed. An excellent road is maintained to Brighton, a summer resort much frequented, but the real views are obtained from the dam sites. Water-works men invited to take this trip when in Salt Lake should have extremely good excuses before declining it. A day is enough but it is guaranteed to produce sleep if not a lasting memory of a wonderful mountain panorama. Incidentally a snow survey is usually made in April of about 10 square miles of the 48 square miles of watershed. Thus the city knows early whether there is likely to be a water shortage for storage purposes long before the runoff reaches the reservoirs. About 400 soundings are made in the survey, every other fork of the stream being covered. About 100 density tests are made averaging around 40 per cent moisture. Getting sufficient water for all of the industrial concerns of the city has not been easy and as the large and small consumers pay the same rate, 4½c. per 100 cu.ft., many efforts are made to obtain private supplies. One of the larger refining companies recently sunk a deep well only to find that when it was pumped it drained the water from 50 individual wells in the vicinity. The city still has the refinery as a customer.

Road and Bridge Work—Some highway work in Utah is at a standstill due to various political causes and differences of opinion between state and federal engineers. For instance, it is with reluctance that the federal engineers will approve an additional 3 to 3½-in. concrete layer as a replacement wearing surface over the structural floor of a bridge. This question of whether to allow abrasive traffic directly on structural portions of the bridge might well be debated with profit over the country. The dual capacity which the upper layer of

concrete must play when cast monolithic and the almost certain impossibility of obtaining a future bond when replacement becomes essential are non-debatable. After noting how the floor slabs in some of the smaller bridges in Utah had been worn down, one could hardly sanction anything but a distinctly replaceable wearing surface over the structural floor.

Lighting on bridges has come into controversy. A fatal accident due to faulty lighting causing an optical illusion has led to a proposal of a radically different lighting system from the ordinary, with the lights on tall poles rather than on the low conventional standards which have the effect of rapidly increasing and decreasing the pupil opening of the eye, thus tending to blind and confuse the driver. Most bridge lighting systems are an abomination from the utility standpoint and could well be given more attention by highway engineers than they are accorded at present.

FLOOD DURING CONSTRUCTION OF GUTTER BEING BUILT TO CARRY JUST SUCH RUNOFF

Close spacing of dams to retain water for curing concrete indicates steepness. High crown even before grading completed deflected water toward gutter.

Returning from the trip to Provo over many of the road sections under construction when a similar trip was made in 1919 but few places were noted not in good condition. This was particularly true of a comparatively thin slag black base and bitulithic top of which there was some doubt when it was laid. True the edges were ragged at some points, but on the whole the main roadway was in good condition. (See *Engineering News-Record*, Dec. 11-18, 1919.)

To a certain extent Salt Lake wants in the railroad line quite the same thing that Denver needs. Both would like to be directly on more transcontinental routes. When the Moffat Tunnel project seemed assured by action of the Colorado Legislature in voting to go ahead with the project, former Governor Bamberger of Utah started to New York to finance the continuation of the line through the Uintah Basin to Salt Lake. This basin is rich in agricultural prospects and natural resources. If an outlet is not found into Salt Lake the traffic emanating therefrom will go in other directions. The governor's task is no light one as the routes will be extremely tortuous and grades heavy over the mountains intervening between the basin and the city.

The natural resources of Utah are beginning to attract developing capital. The Utah Steel Co. is planning to spend $300,000 in sheet and plate mills and hopes to be able to raise two or three million dollars this year for blast furnaces. A 60,000-ton mill will probably be in operation before long. For sheets, plates and reinforcing bars the company hopes to compete successfully East as far as Omaha and West for trade on the Pacific Coast and the Orient. All of the raw products, coal, iron and limestone are within reasonable distance of the small plant now in operation. Practically all of the haul is down hill.

Irrigation—Irrigation development is Utah's middle name, meaning that without irrigation she was nothing and that water is her life blood. The pioneers the first year lived on Seger lily bulbs, thistle tops and cactus apples but no one since that time has had the least desire to repeat this experiment. So water storage is being studied seriously to utilize all the water available to best advantage. Richard Lyman, professor of civil engineering, University of Utah, and recently elevated to be one of the twelve apostles of the Mormon church (no small honor) is now a member of the Utah Storage Commission which has taken up officially the work so well started by A. F. Parker (See *Engineering News-Record*, May 27, 1920, p. 1064). The commission is working in conjunction with the U. S. Geological Survey on the Jordan and Weber Rivers first.

Professor Lyman received me in the million dollar church office building and arranged for me an inspection of this marvelously beautiful structure of Ionic architecture. The many striking marbles of Utah are used throughout, except for the floors, for which Tennessee marble, because of its wearing qualities, is considered preferable. No engineer or architect visiting Salt Lake should miss the opportunity of seeing this building if he is so fortunate as to get an invitation to view it.

To return to irrigation Professor Lyman mentioned the many-times suggested scheme of pumping Utah Lake down to a much lower level, thereby reducing its large area of shallow water with its tremendous evaporation loss. Much land in Toole County around Garfield Point which projects nearly into Great Salt Lake could then be brought under cultivation and the water saved. Other engineers, however, hold that between the city and Great Salt Lake 70,000 acres of land could easily be drained and should be utilized first because of its proximity to the city.

Ogden is paving a lot of its wide streets. Work on more than thirty blocks is under way. This means much water pipe extension and 1,500 tons of 12 to 20-in. pipe will be put underground this season. Heretofore steel pipe only has been used but W. S. Craven, new city engineer, drew up the specifications for cast iron as well as steel, although his estimate indicated that the steel pipe would cost but 84 per cent as much as cast iron. Mr. Craven is starting an experiment looking to an increase in the supply of artesian well water located in a valley up Ogden Canyon back of the city. The wells now flow, but 8 out of 30 are to be pumped with air lifts to increase their output. Whether the underground storage held back by a natural dam at the inlet to the canyon will prove to be as prolific in water as the officials hope will not be known until at least this season is over. What is going to happen as to storage and interference of the various wells, as well as other underground phenomena will be interesting.

Ogden and Salt Lake are connected by a 37-mile highway ribbon of concrete. The agricultural development between is so intense that the suburbs of one seem almost to touch those of the other. So do engineers and the works of civilization shorten the lines of intercommunication. No one can say that Utah engineers are behind their eastern brethren in utilizing the forces of nature to the benefit of man.

Condition of Railway Transport in Soviet Russia

Unfit Locomotives, Bad-Order Cars and Bad Fuel Handicap Operation—Repair Parts Lacking and Wages in Arrears

IN A recent issue of *Commerce Reports* appears a summary of railway transport conditions in Soviet Russia as compiled from statements made in the Soviet official daily, *Economic Life*, for whose accuracy, however, the Department of Commerce assumes no responsibility. The following abstract presents the substance of that summary:

Locomotives and Fuel—The actual number of sound locomotives, the number per 100 miles of track in actual use, and the percentage out of commission are shown in the following table. Idle engines represent those classed as sound but sidetracked for lack of fuel. The data for 1914 represent substantially the area now included in Soviet Russia in Europe. All statistical data include the Ukraine and the Caucasian States.

Date	Mileage of Lines in Use	Sound Engines	Ratio per 100 Miles	Per Cent of Unfit Engines	Idle Engines
Normal of 1914	41,500	17,140	41.3	15	....
November, 1917	33,180	15,154	45	27.4	....
July, 1920	39,000	6,232	16	58	270
January, 1921	40,000	7,544	19	57.4	429
July, 1921	40,000	7,167	18	57.9	587
January 1, 1922	40,700	6,538	16	64.3	1,296
April 1, 1922	41,400	6,302	15.2	67	387
May 10, 1922	41,400	6,931	16.7	63.8	410

Unsuitable fuel has recently done much damage to engines, and instances have been common during the past winter of brand-new locomotives being sent in for repairs after a couple of months operation. The principal trouble was with wood, although the coal was constantly complained of as being full of ash and cut too heavy for the fire boxes. A report of the commissariat of transport, dated March 3, 1922, states: "The wood is dumped on the tenders in sections of logs, sometimes hardly even trimmed, and is damp right through and encrusted in snow and ice. This sort of fuel rapidly causes wholesale leakage of fire tubes and the breaking up of grates."

Cars Available—The number of cars available for service from the middle of 1920 to May, 1922, is shown in the following table:

Date	Total Number Cars	Unfit Cars	Per Cent Unfit
July, 1920	442,985	90,093	20.3
January, 1921	447,594	87,585	19.5
July, 1921	444,266	114,536	26.0
January, 1922	419,819	118,745	28.3
February, 1922	415,987	119,936	29
February, 1922 [1]	394,342	115,849	30
April 7, 1922 [1]	387,420	170,387	44
May 10, 1922 [1]	392,927	183,298	47

[1] Freight cars only, not including tank-cars.

Scarcity of Repair Material—The following statement is published in *Economic Life* for Feb. 22, 1922, from the official report of the chief transport committee regarding the repair of transport equipment: "The supply of materials and spare parts has dwindled to alarming proportions, especially during the past few months, since the works and stores, having been put on a business operating basis, demand spot payments from the commissariat of transport, while the commissariat has no funds at its disposal. An utterly abnormal situation has been created when articles and materials of repair badly needed for the rolling stock are lying at the works and factories and cannot be obtained on any account, while at the same time the transport service is being strangled for the need of these articles.

Traffic Figures, 1916-1922—In 1916 the average number of daily car loadings was 35,900; in 1919, they were 8,973; in 1920, they were 15,308; and in 1921 they numbered 10,614. The average for January, 1922, was 8,820 cars and for February 8,750 cars.

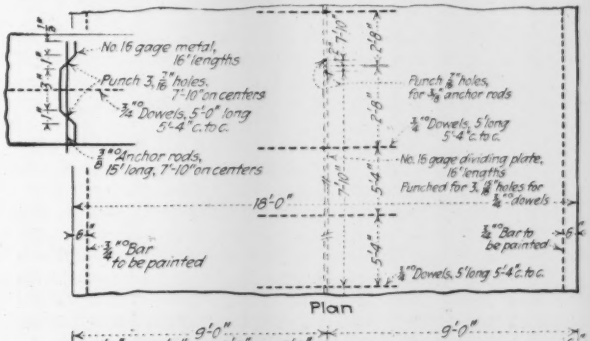
The total quantity of freight carried in 1921 amounted to 2,400 million poods as against 15,500 million poods for the same track mileage of Russian territory in 1913. (A pood equals 36.1128 lb., roughly then there are 62 poods to the long ton.)

According to the official report already quoted, the financial condition of the railroads calls for drastic measures. The deficit for the months of January and February amounted to 94,000,000 pre-war rubles, or 14.1 trillion Soviet rubles at the March rate. On several railroads up to February, at least, the men had not as yet been paid for November. The actual rate of pay due for that month was 165,000 Soviet rubles per man, but on account of rise in prices this became equivalent (figuring the purchasing value in February) to only 8 lb. of rye bread per employee for the month.

Plan of Operation for 1922—The chief transport committee decided to divide the railroad system for 1922 into three groups or zones according to the importance of their work to the state. The first group of trunk lines, supposedly most essential to the economic and political power of the Soviets and aggregating 20,500 miles (first main-track mileage), were to receive 100 per cent of their requirements. The second group, representing the branch lines feeding the railroads of the first category and totaling 6,950 miles, were to be taken care of to a less extent. The lines of the third group, 14,000 miles, were to receive their supplies irregularly, and the traffic on them would be operated sporadically, subject to complete suspension as occasion might require.

Two-Strip Concrete Pavement Built on Ohio State Roads

A NEW development in Ohio in concrete road design is the split slab with a buckle-plate joint doweled every 5 ft. 4 in. and with continuous dowel rods along the edges. In general the design resembles that employed during the last two years in Illinois and described in *Engineering News-Record* March 24, 1921, p. 504, but the buckled joint plate is that used in New Jersey and described in *Engineering News-Record*, June 8, 1922, p. 963, except that in the Ohio design the plate is completely submerged and the slab is finished smooth over its top.


No. 16 gage metal, 16" lengths
Punch 3, 13/16" holes, 7'-10" on centers
3/4" Dowels, 5'-0" long 5'-4" c. to c.
3/8" Anchor rods, 15" long, 7'-10" on centers
No. 16 gage dividing plate, 16" lengths
Punched for 3, 13/16" holes for 3/4" dowels
18'-0"
3/4" Bar to be painted
1 1/4" Dowels, 5' long 5'-4" c. to c.
Plan
9'-0"
2'-3"
Section

SPLIT SLAB CONCRETE ROAD IN OHIO

LETTERS TO THE EDITOR

This Department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Amusement Riding Devices Are Safe

Sir—Your issue of June 22 contains an editorial (p. 1022) entitled "Dangerous Amusement Devices," which deals with the Ferris Wheel largely and condemns these rides and advocates the abolition of amusement machines. We maintain that you should now publish the other side of the case and allow the writer the same amount of space to show the favorable side of the business.

I have built and operated amusement riding devices for nineteen years in this country, in Canada, Mexico, South America, Spain, France, Belgium, England, Austria, Germany, Italy, and the Philippines, and have never had an accident, having carried millions of people during that time.

When there is a railroad wreck you do not ask the abolition of railroads and when there is a smash-up with automobiles you do not ask the abolition of automobiles. Therefore, we think, in the light of fairness, you should allow the writer the same amount of space in your publication to show the conservative side of this question. R. S. UZZELL.

New York City, Aug. 9.

A Dissenting View on Rivet-Hole Deductions

Sir—Regarding the net section of riveted tension members and your review of Prof. C. R. Young's bulletin on this subject as well as D. B. Steinman's comment in your issue of June 22 permit me to say that in my judgment the profession is entitled to know just what is the experimental proof of the correctness of the theory employed both by Prof. Young and Mr. Steinman.

Prof. Young has ignored tests which I made and published in *Engineering News*, May 3, 1906. These tests proved that a bar is equally liable to break in a right transverse section or a zigzag section of the same area. This is quite contrary to the rule that was in force at that time and to the theory used by Young and Steinman, all of which require a large addition in area in a zigzag section. The experiments which Prof. Young cited are not pertinent to the case but were on riveted splices. Also I called his attention to the fact that at the time my experiments were published no defense of the 30 per cent excess in a zigzag section was brought out excepting one, which was from Theodore Cooper, and his experimental confirmation was from riveted plate splices and not riveted or punched tension members.

A plate splice is not equivalent to a tension member with holes punched out of it. In the latter the stress has only to distribute itself around the holes. In the former each rivet is a concentrated load tending to tear the metal beside the hole. Tests on plate splices are therefore valueless for any other purpose than to discover the value of such splices. My tests were made on plates having holes so located that there was equal area in either a zigzag or a transverse section. Some of them broke in the transverse line, proving that no excess area is needed in the zigzag section, as Cooper, Young and Steinman assert.

The theory of combined stresses is a mere hypothesis until it is at least approximately confirmed by tests. The theory that treats a cube of metal in the body of a member as though it were isolated and free to revolve (through an infinitesimal angle) ignores the rigidity of the metal in which that cube is embedded. Such theories as this one and the one on which Poisson's ratio is based have never, to my mind, received theoretical confirmation.

The rule which I advocate is that the zigzag area be equal to that required in a transverse section. Unless my tests can be shown to be controverted by other tests, Cooper's rule, the one given in the Am. Soc. C. E. Tentative Specifications for Railroad Bridges, and those given by Young and Steinman mean a large waste of metal.

I should like to see some definite constructive response to this letter that does not refer to tests on some other thing than the net section of riveted tension members.

Pittsburgh, Pa., June 26. EDWARD GODFREY.

Water Power Auxiliary to Steam

Sir—I note your editorial concerning "Water Power Auxiliary to Steam."

In a report which I made on a water power in the State of Pennsylvania, dated May 24, 1916, occurs the following paragraph:

"We have calculated a large number of combinations of steam and water based on running the water power at a high load factor in connection with the steam plant used as an auxiliary, and then again, figuring the steam plant with a high load factor and the water power as an auxiliary; and after analyzing all these layouts we find the best results would be obtained by taking the steam power on a 100 per cent load factor during the time at which it is run when the water is below the crest of the dams and by operating the water power at that time at 33⅓ per cent load factor. The combined load factor of the entire plant would be 50 per cent. During the time when there is water enough to run over the crest of the dam the steam and water plant would be run at about 50 per cent load factor. For this purpose one of the best combinations possible is a 135,000 kw. water plant and a 54,000 kw. steam plant."

J. W. LEDOUX,
Consulting Engineer.

Philadelphia, Pa.,
July 8.

A Tasmanian Concrete Flume

Sir—You published an excellent article on reinforced-concrete flumes in *Engineering News-Record*, March 16, p. 436, built by the U. S. Reclamation Service. Herewith is a description of a concrete flume, the construction of which involved some features essentially different from those described in your article.

In order to increase the capacity of its Great Lake hydro-electric scheme, the State Hydro-Electric Department of Tasmania recently constructed a diversion channel from the Ouse River to the Great Lake, situated on the central plateau of Tasmania, at an elevation of about 3,500 ft. A portion of this channel consists of a reinforced-concrete flume. A small diversion weir was constructed in a deep and narrow gorge and below this weir the flume winds along the sides of the gorge into the head of a canal. For a portion of its length the foundation consists of a rock fill, but for the greater part it takes the form of a bench excavated in the almost precipitous sides of the gorge.

Coarse aggregate for the concrete consisted of diabase quarried near the mouth of the gorge and crushed to 1-in. size. Fine aggregate was washed from excavated material and consisted of a mixture of quartz-sand and clay. Material was loaded through chutes from the storage piles to ¾-yd. trucks running on a 2-ft. gage track laid on the flume foundation, the trucks being drawn by a horse.

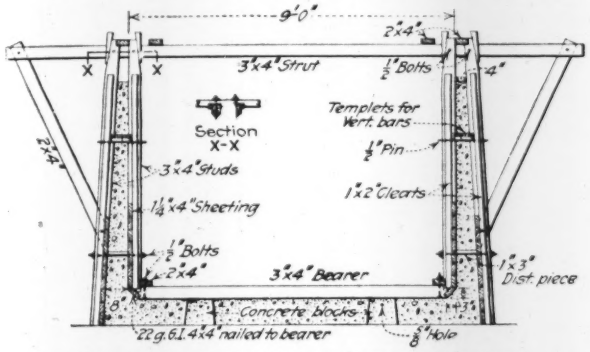
The rough foundation was trimmed with crushed stone and given a smoothing coat of 1:3:6 concrete carefully screeded off to grade. Besides preventing some of the 1:2:4 concrete, used in the flume, from being lost in the stone of the foundation, this smoothing coat provided an accurate surface on which to erect the forms and also enabled material, dumped from the trucks, to be easily shoveled into the mixer. The discharge of surface water from the sides of the gorge was provided for by the construction at intervals of concrete box-drains.

The flume foundation provided the only route for the conveyance of material both to the flume and the weir, and this was the controlling factor in the design of the forms and the construction methods adopted. As much material as possible was stored at the weir site before commencing the flume, but the balance was transported through the flume forms on the 2-ft. gage track.

The flume has walls 6 ft. high, an inside width of 9 ft.

and a capacity, when running 5 ft. deep, of 450 sec.-ft. The walls are vertical on the inner face, the outer face being inclined. Transverse reinforcing bars are spaced 7 in. c. to c., every third bar extending to the top of the wall but the intermediate ones stopping at lower levels.

The forms consisted of frames spaced 4 ft. c. to c., the outer studs resting directly on the concrete foundation. The inner studs were supported on 4-in. x 3-in. bearers resting on precast concrete blocks, built into the floor. Sheeting was supported against cleats nailed to the studs. The correct spacing between inner and outer studs at the top was maintained by wedging against shoulders on the top strut, and near the bottom by wooden distance pieces and tie bolts, the former being removed after concreting the floor. After the walls had set sufficiently, the tie bolts were withdrawn and the holes filled with grout. The frames were braced laterally by outside diagonals and light struts were sometimes nailed on in addition to stiffen the forms further. The frames were spaced by 2-in. x 4-in. longitudinals notched for each stud. The rails of the track rested directly on the 3-in. x 4-in. bearers, the sleepers hanging in the intermediate spaces. Light removable ramps provided a grade into and out of the forms and planks laid between the rails formed a track for the horse.



SECTION OF TASMANIAN CONCRETE FLUME

All reinforcement was bent to shape on a bending table placed at the mouth of the gorge. Longitudinal bars were in random lengths and were lapped 40 diameters where they broke joints. Transverse bars were made in one piece, the ends being hooked. Plain round bars were used throughout. The concrete blocks had holes in them through which two of the ½-in. longitudinal bars were passed. These bars supported the transverse bars which in turn supported the remaining longitudinal ones. Bars were tied at each intersection. The transverse bars were spaced and supported in position in the walls by wooden templets which were made in two pieces and rested on steel pins passing through the studs. These pins were later withdrawn and the holes grouted.

One hundred frames were used and sufficient sheeting was provided to permit forms to remain in place for at least three days, as low temperatures were common in the locality even in summer. Sheeting was used five or six times, some pieces lasting longer than others. All portions of the forms in contact with the concrete were originally oiled but not again before re-using.

An air line from a compressor at the mouth of the gorge was provided with outlets at each 100 ft. and, on completion of the excavation, the line was connected to a pump and used to convey water to a hose by means of which the concrete was regularly sprayed for about seven days after placing.

A joint extending through walls and floor was put in at intervals of 50 ft. Before filling the wall joints, the galvanized iron was pierced by a vertical row of small holes spaced 3 in. apart and small stirrups of No. 10 wire were hung through the holes to bond the mortar on the outside to that on the inside of the joint. Before filling, one end of the joint was oiled in order that the mortar should bond to the concrete on one side of the joint only. Small vertical cracks have appeared in the walls midway between joints but, after being in service for one year, the flume is reasonably tight.

Work was commenced at the upgrade end and 100 ft. of forms were erected at a time, a similar length of track being lifted. At the same time the track was relaid in the section behind. The mixer was stationed on the foundation immediately outside the forms and was provided with measuring hoppers. The reinforcement was brought up close to the forms on trucks and by means of a short turnout the sand and stone were dumped from the trucks onto the foundation in small piles from which they could be easily shoveled into the mixer hoppers.

The general design of the forms was the outcome of the conditions governing conveyance of materials and they proved fairly satisfactory under those conditions. Where an independent construction road can be made alongside of or near to the flume, the method of working from the inside of the forms is not to be recommended, but, where this procedure cannot be avoided, the type of sheeting adopted, whereby the wall forms are built up as they are filled, has the advantage that the minimum amount of lifting of the concrete is attained. Further, as the concrete is never far below the top of the forms, it can easily be well spaded and worked against them in order to obtain a good surface without employing an unduly wet mix. A slight disadvantage arises from the fact that the pieces of sheeting are not exactly of the same width so that the last piece does not coincide with the level of the top of the concrete in the wall and cannot be used as a screed for striking off the top of the concrete. By marking the top of the wall on each of the studs, however, it was found that a man could trowel the top of the wall with sufficient accuracy to satisfy the eye.

The work was carried on by the labor of the Hydro-Electric Department of Tasmania, of which J. H. Butters is chief engineer and general manager, and A. H. Bastow engineer for hydraulic construction. The writer was resident engineer on the diversion scheme and was assisted by A. E. Kelso, who was in immediate charge of the concrete work.

W. NIMMO, Assistant Engineer,
Hydro-Electric Department.

Hobart, Tasmania, May 8.

Deflection vs. Impact in Concrete Road Tests

Sir—In *Engineering News-Record* of June 29, 1922, p. 1065, there appears an editorial pertaining to the Pittsburg (Cal.) roads tests. I was much interested in this article, as well as the detailed article on page 1066.

In the fourth paragraph in the article on p. 1065 reference is made to the disintegration beginning at construction joint and transverse cracks and emphasizes the effect of impact on a road surface. Unfortunately, due to the volume of detail work in connection with the making of these tests at Pittsburg, accurate and systematic measurements of deflections at transverse construction joints and transverse cracks was not carried on.

From my observation of failures in concrete roads I am firmly convinced that failure is the result of the deflection in a concrete slab exceeding certain permissible amount. From measurements made by myself at Pittsburg I determined to my own satisfaction that slab failure bore a direct relation to slab deflection, regardless of impact. In other words, the transverse crack, whether it be a construction joint or otherwise, weakens the pavement to the extent that a very considerable deflection takes place over that which occurs at points where there is no transverse crack. The amount of this deflection is in most cases determined by the character of the subgrade. It is interesting to know that no failures occurred over the tunnels where all of the impact tests were conducted. Some of the roughest concrete roads in California have stood up much better than other roads with much smoother surfaces.

The only point that I wish to make is that the word "deflection" in my opinion, should be substituted for "impact" in the great majority of cases where failure in concrete slabs is under discussion.

E. E. EAST.

Los Angeles, July 10.

NEWS OF THE WEEK

New York, August 31, 1922

Rules Issued for Federal-Aid Road Work

Secretary of Agriculture Outlines Policies to Govern State Highway Departments

Rules and regulations for administering the federal highway act of Nov. 9, 1921 have been promulgated by the Secretary of Agriculture, for whom the work will be carried out under the general direction of the U. S. Bureau of Public Roads. The chief points in the new regulations are summarized below:

On request the state highway departments, before any agreement is reached regarding road construction, shall furnish information regarding state legislation, organization and equipment of the highway department, funds available and provision for maintenance. Each state is required to file with the Secretary of Agriculture a statement showing the proposed federal-aid highway system, and indicating the primary and secondary routes, constituting, respectively, three-sevenths and four-sevenths of the so-called 7-per cent system. The Secretary will inform the state highway departments of the acceptability of the system and when agreement is reached on the whole or a part of the system the state shall make a formal request for approval. Pending formal approval, only such projects will be approved as are on routes indicated on the proposed federal-aid highway system. After the federal-aid highway system shall have been selected, designated and approved, no project statement shall be submitted for any route or part of any route not embraced in the system. Until plans, specifications and estimates of cost for the project shall have been found satisfactory, no project shall be placed under contract.

Advertising Essential

Grade crossings shall be classified for priority between the state departments and the Bureau of Public Roads. No part of the expense of surveys, plans, specifications or estimates prior to the beginning of construction work shall be included in the estimate or paid by the federal government. No federal money shall be paid "until it has been shown to the satisfaction of the Secretary of Agriculture that adequate methods, either advertising or other devices appropriate for the purpose, were employed, prior to the beginning of construction, to insure economy and efficiency in the expenditure of such money." If the contract be awarded to any other than the lowest responsible bidder, the federal government shall not pay more than its pro rata share of the lowest responsible bid, unless it be shown that it was advantageous to the work to accept the higher bid.

No part of the money appropriated under the act shall be used directly or indirectly to pay or to reimburse a state, county, or local subdivision for the payment of any premium or royalty on any patented or proprietary material, specification, process or type of construction, unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods, if any, equally suitable for the same purpose.

Bids Opened on $4,600,000 of Road Work in North Carolina

The North Carolina State Highway Commission received bids at Raleigh, Aug. 30, for the construction of 197 miles of state highways, estimated to cost over $4,600,000. Of this amount $839,000 is for reinforced-concrete bridge and culvert construction.

About 120 miles are of standard plain or reinforced concrete, or asphaltic types of paving; 9 miles are of waterbound macadam; and 68 miles are of topsoil, sand-clay or gravel construction. It is believed that this is one of the largest lettings of state highway construction ever offered by a state highway department in a single day.

Philadelphia Building Congress Is Organized

At a meeting in Philadelphia recently of the construction conference group which has been functioning during the past two years informally along lines conforming to the activities of the National Federation of Construction Industries and of the New York Building Congress, the organization of what is to be known as the Philadelphia Building Congress was effected. Matters transacted at the meeting included adoption of the constitution and by-laws, the creation of several committees with important functions, and the election of officers, *pro tem.* Officers elected were: President, D. Knickerbacker Boyd; vice-presidents, James W. Pearce, Edwin L. Seabrook, and Harry C. Woods; secretary, H. J. Baringer; and treasurer, Herbert L. Towle.

Educational Classes by Chicago Chapter of A.A.E. to Reopen

Classes on "Railway Management" and "City Management," which were inaugurated last winter by the Chicago chapter of the American Association of Engineers, will be reopened in September. The former will cover the work of station agent, yardmaster, trainmaster, roadmaster, superintendent and division engineer. The latter will include budget making, taxation, charters, municipal corporations, public accounting, civil service and the purchase and issue of supplies. A third class is proposed and three subjects for this have been submitted for vote of the members: "Engineering Administration" "Business Administration" and "Building Superintendence."

Flood-Control Legislation Hearings Postponed

Meetings Planned in Hope That Those Most Interested May Decide on Form of Legislation Wanted

Washington Correspondence

Hearings set for September 5 before the flood-control committee of the House of Representatives, at which further flood-control legislation was to be discussed, have been postponed in the hope that those most interested in the legislation may agree on the form it will take. Some of the people in the lower Mississippi Valley are demanding that the federal government pay the entire expense of bringing the levee line up to the grade and cross-section recommended by the Mississippi River Commission, and in addition leveeing the trbutaries and outlets of that stream. They contend that the flood waters originate in many states and reach dangerous heights on the lower stretches of the river because all natural reservoirs have been eliminated and because tile drainage on northern farms and other works of development make for a more rapid runoff.

Contrary Views Held

Others in the lower valley contend that the federal government is not likely to agree to assume the entire burden of flood control and even if it did would continue its levee work in the same halting manner made necessary in the past by the limitation put on appropriations. Since the losses from a single overflow are greater than the entire amount involved in completing the levee system, this faction proposes that the local interests pay the entire bill. This plan, they argue, has the advantage of allowing the work to be done under continuing contracts under which levee building could be prosecuted as rapidly as physical conditions permit. Since most of the levee boards in the lower valley have not only exhausted reserves but anticipated incomes for several years in making the recent high-water fight, it is proposed that the federal government advance $50,000,000 for bringing the levees up to standard and for the construction of levees on tributaries and outlets. The amount is to be covered by levee board bonds bearing interest at the rate of 4½ per cent, to be repaid on an amortization plan which will allow their liquidation during a period of forty years.

There is still another faction in the lower valley which favors additional appropriations under the existing flood-control act. Practically all of the money authorized by this act has been appropriated. Under the terms of the flood-control act two-thirds of the cost of levee construction is paid from the federal treasury.

With such divisions among those most interested in the legislation, it is recognized that the chances would be better if the local interests can decide among themselves which form of legislation they will urge.

State Water-Works Convention at Filtration Plant

The filtration plant of the water-works at Gastonia, N. C., has been chosen as a meeting place for the North Carolina Section of the American Water Works Association, Nov. 14 and 15. There will be an exhibit of water-works appliances. The program includes a variety of topics to be presented by some two dozen speakers. The secretary-treasurer of the association is Prof. Thorndike Saville, of Chapel Hill.

Street Sanitation Association To Meet in Chicago

The International Association of Street Sanitation Officials will meet in Chicago Oct. 9 and 10, with headquarters at the Hotel La Salle. There will be morning and afternoon sessions Monday, Oct. 9. It is expected that the following day will be devoted to a boat trip to the locks of the Chicago Sanitary Canal. The date has been changed from that given in an earlier announcement on account of the meeting of the American Society for Municipal Improvements at Cleveland, Oct. 2-6. The president of the association is W. J. Galligan, Bureau of Streets, Chicago, and the secretary is A. M. Anderson, 10 S. La Salle St., Chicago.

Complete Cofferdam No. 2 at Wilson Dam

Rapid progress is being made by the Army engineers in the construction of cofferdam No. 2 across the north channel of the Tennessee River at the Wilson dam, Muscle Shoals, Ala. It probably will be possible to start the work inside of this cofferdam before Oct. 1 when the $7,500,000, recently appropriated, becomes available. With that money it is intended to continue raising the section of the dam already started and to complete the foundations for the power house. The remainder of the appropriation will be used to carry forward the construction of the power house just as far as the money will permit.

Military Engineers at Ball Game

Col. T. L. Huston, a director of the New York Post, Society of American Military Engineers and part owner of the New York Yankees, entertained the members of the post at a double-header session between the Yankees and the St. Louis Browns on Aug. 25.

British Engineering Joint Council Formed

According to a recent communication from the British Institution of Mechanical Engineers and Engineering Joint Council composed of representatives of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects and the Institution of Electrical Engineers has been formed. The object of the Joint Council will be, among others, to improve the status of engineers, to secure the better utilization of their services and the appointment of properly qualified individuals to responsible positions, and to prevent the unnecessary duplication of activities. Emphasis is placed upon the fact that at the present the Joint Council is composed of the four principal British engineering societies. However, it may be that the Joint Council will be increased in size but that remains a matter for future consideration for the Council and the institutions concerned.

Hydro Works for Gatineau River

Following negotiations which have been in progress during the past five years the Hull Electric Co., Hull, Ont., Can., has acquired a large number of properties along the shores of the Gatineau River, including riparian rights to Paugan falls situated about 35 miles from the city, and upon a selected site later on will commence the construction and installation of a hydro-electric power development which will have an ultimate capacity of 150,000 hp.

This development involves the constructon of a concrete dam 125 ft. high; and will form a reservoir above the dam about 15 miles in length. It is understood the ultimate cost of the scheme will be in the neighborhood of $10,000,000.

It is also understood the final surveys in connection with the Paugan falls development will be undertaken this fall, and that construction work will be started next summer.

Flood Outlet for Lower Mississippi Proposed

New Orleans Engineer Committee Would Divert Flood Waters to Lake by Spillway

A report has been drawn up by a committee of five New Orleans engineers recommending an artificial outlet six miles below Jackson Barracks, New Orleans, by which flood waters of the Mississippi River will be discharged into Lake Borgne. The committee reports that a spillway 6,000 ft. wide and about 5 miles in length at such a location could be built for between $4,000,000 and $5,000,000, including the price of the land that would have to be purchased. No outline of the plan for raising the money or for obtaining legal authority to undertake the work is included. The report was submitted to the Safe River Committee of One Hundred by the following five men: John Klorer, city engineer, chairman; Col. Allison Owen, Prof. W. B. Gregory, J. B. Kemper and Hampton Reynolds. This report, which is the first definite relief measure proposed for the Lower Mississippi, will be placed before Major-General Lansing H. Beach, Chief of Engineers, U. S. Army, within the next few days during his visit to New Orleans.

Spillway Believed Justifiable

The committee has investigated the records of the New Orleans water purification plant and has found that there seems to be no direct ratio between the higher gage heights and the degree of turbidity of the water during floods. Therefore, if the river is capable of carrying in suspension its maximum load of silt with slopes such as it has at stages 6 or 7 ft. below the maximum height, the fear that it may drop its sedimentary load as a result of lowering this height below the spillway may justly be questioned.

The proposed spillway would give a discharge of 30,000 sec.-ft. with the Canal Street river gage at 16 ft., and a discharge of 250,000 sec.-ft. (or a lowering of the river height of 4.2 ft.) when the Canal Street gage would stand at 20 ft.

ABOVE—PROGRESS MADE ON COFFERDAM NO. 2, WILSON DAM, ON JULY 31, 1922. BELOW—ONLY OPENING LEFT ON AUG. 2, 1922

Conservation Association Formed in Texas

Pertinent Hydraulic Data to be Compiled —Engineer Council Outlines Needed Work

Conservation in Texas continues to be a live issue, and the Texas Conservation Association, formed at Waco, Aug. 16, represents the first actual step taken by the state in the control of its flood waters. Following closely on the heels of a meeting of Texas civil engineers called Aug. 7, at Austin by Governor Neff to formulate plans for flood protection, the Waco meeting presented the same subject to the engineers and the business men of the state combined and Leonard Tillotson, of Sealey, was chosen president. Homer D. Wade of Fort Worth, assistant manager of the West Texas Chamber of Commerce, who issued the call for the conference, was elected secretary-treasurer. Vice-presidents selected were: Carl S. Guinn, Ballinger; John M. Lawrence, Bryan; W. D. Wilson, Bay City; E. C. Snow, La Feria; Sam T. Morgan, Dallas; J. A. Kemp, Wichita Falls; and W. T. Eldredge, Sugarland.

PLAN OF ORGANIZATION

The plan of organization suggested and adopted provides for an annual meeting to be held on the second Tuesday of July at which officers will be chosen. Other meetings are to be held at the call of the president or when requested by five or more members of the legislative committee. A feature of the plan of organization calls for an advisory council of engineers which is made up as follows: Chairman, Dean T. U. Taylor, University of Texas; John B. Hawley, Fort Worth; C. T. Bartlett, San Antonio; E. E. Sands, Houston; Fred A. Jones, J. C. Nagle, E. N. Noyes, Dallas; W. F. Shaw, Mercedes; F. A. Merritt, Galveston; V. L. Sullivan, El Paso; E. H. Sellards, Texas Bureau of Economic Geology; R. A. Thompson, Wichita Falls; and W. B. Tuttle, San Antonio.

Instructions to the engineer committees for the fifteen drainage areas of the state, covering methods to be followed in securing rainfall, stream-flow, dam-site, flood-mark, and other essential data were to be sent to these district chairmen by the council by Aug. 25. The council has also begun a comprehensive, detailed study of the needs of the State Reclamation Department and the State Board of Water Engineers, and will submit suggestions as to the scope of the works to be undertaken and accomplished by them, respectively, during the coming two years, with estimates of probable cost.

SEEK LEGISLATIVE SUPPORT

Among other resolutions, one was addressed to the state legislature urging "the importance of extending to this movement for reclamation and flood control the active co-operation of the departments of the state government, by directing the State Board of Water Engineers, and the state reclamation engineer to secure at as early a date as may be practicable a topographic and hydrographic survey of the watershed area of the principal streams of Texas; to make stream measurements, with estimates of the volume of flood waters such stream channels are capable of discharging; to prepare estimates of the volume of surface and flood waters to be controlled, and the storage capacity essential to their conservation; to ascertain the location of reservoir sites, with estimates of capacity and the cost of impounding dams; to investigate the feasibility, usefulness and probable cost of straightening stream channels, and by directing the proper state agency to conduct a survey of agricultural land in the watersheds of rivers most affected by soil erosion, and to make recommendation thereon"; and to provide funds to enable the said departments of the state government to develop and assemble such engineering data as expeditiously as is consistent with accuracy and reliability.

Montreal Approves Port Improvement Plans

Plans for the improvement of Montreal harbor involving an expenditure estimated at $4,319,849 have been officially sanctioned by Hon. Ernest Lapointe, Canadian Minister of Marine. The following are the important works to be constructed: Grain elevator, $2,347,000, with an initial capacity of 2,000,000 bu. and an ultimate capacity of 8,000,000 bu.; extension to the high-level quay walls, $475,000; extension of wharves and piers, $900,000; improvement of the channel approach, $97,849; and paving and extension of harbor railway terminal, $50,000. The money will be provided from a loan of $5,000,000 made by the government to the Harbor Commissioners. The construction of a bridge to the south shore has been definitely decided upon and $50,000 have been appropriated for preliminary work and plans. The bridge, estimated to cost approximately $10,000 000, will be built under the supervision of the harbor engineering staff and preliminary work is now in progress.

Logging Trucks are Washington Road Menace

In the State of Washington logging operations in which motor trucks are used to transport logs from woods to boom have been operated with loads of 18 tons, and it is claimed by logging companies that it is unprofitable to operate with smaller loads. A gross load of 12 tons per vehicle is the maximum permissible loading that may now be operated over Washington highways and as a result the transporting of logs by truck has materially decreased. The logging truck is charged with causing practically all the damage to Washington highways that has resulted from the operation of vehicles. The Washington standard for state highway paving calls for a minimum center thickness of 6¾ in. on which, state highway officials assert, anything now operating on pneumatic tires is unlikely to cause damage.

Mediators Fail to Settle Shop-Crafts Strike

Following the general meeting of the Association of Railway Executives held in New York last week a group of railroad presidents representing 52 companies, aggregating 85,000 miles of line, continued in conference with the leaders of the five train-service brotherhoods who had been acting as mediators in the shop-crafts strike.

These executives were unwilling to agree to any plan of settlement that would affect the rights of loyal employees and those hired since July 1, but were willing to pledge themselves to find employment at the same terminal points as before, at their usual class of work, and at the Railroad Labor Board rate, for all strikers not guilty of proved acts of violence.

The roads disclaimed any desire to curtail the pension rights or other privileges that the strikers had earned by virtue of their term of service and offered to take the men back with such privileges unimpaired. These roads stated that they were in position to do this without prejudice to the rights of the loyal employees.

The proposal contemplated further that if after the men returned to work there remained any unsettled disputes that could not be settled in conference, such matters should be referred for final determination to a commission of ten members to be composed of the five train-service brotherhood executives acting as mediators and five railroad executives experienced in such matters.

This proposal was rejected by the shopmen, largely on the ground that separate agreements with the roads in question would weaken the position of the men of other roads now on strike. The mediators have given up hope of a settlement at this time, and both railroad executives and shop-crafts leaders express their intentions of carrying on the struggle to a finish.

Corps of Engineers to Utilize Water Transportation

Due to the transportation situation and the likelihood of there being a car shortage throughout the winter, the Corps of Engineers expects to resort to water transportation in securing the materials needed for their river and harbor projects. Difficulty already has been experienced in securing deliveries of cement. To supply its Ohio River projects, the Corps of Engineers is bringing cement by barge from Hannibal, Missouri.

Texas Bonds Bring Premium

The highest bids offered on bonds of the city of Dallas for some time past were received recently by the Board of Commissioners when a premium running as high as 5½ per cent was offered in the fourteen bids opened. Three issues of city bonds were involved, amounting to $800,000, including a $560,000 street-improvement issue, the $140,000 school issue, and the $100,000 sanitary sewer issue, all bearing 5 per cent interest and maturing in forty years. The actual price offered was $105.57.

New York Mayor Plans Municipal Rapid Transit System

Plans for a city-owned and city-operated rapid transit system for New York have been announced by Mayor Hylan of that city. The proposal contemplates the "recapture" of about 100 miles of existing subways now operated by private companies and the construction of 126 miles of new lines, together with new cross-river tunnels and bridges and a $25,000,000 bus system. The cost is estimated at $600,000,000 which, together with the $300,000,000 of city investment in the existing subways, would make a total municipal transit investment of $900,000.000.

The plan for operation contemplates the termination, as soon as legally possible, of the existing partnerships between the city and the two operating companies, the Interborough Rapid Transit Co., and the Brooklyn Rapid Transit Company. The fare on the new system is to be fixed at 5 cents and universal transfers between its lines are to be issued.

It is anticipated that the submission of this plan at this time as an offset to that of the Transit Commission, the only body having legal authority to initiate and carry out transit improvements (see *Engineering News-Record*, May 18, 1922, p. 842) will have an important influence on the fall political campaign in New York State. The Transit Commission was created by legislation fathered by Governor Miller whose term expires next January; and the city administration has been consistently hostile to the commission's conduct of transit matters and its plans for transit expansion. The plans of the Transit Commission are blocked, owing to the necessity of its obtaining funds for construction from the New York city administration; and the Mayor's plans are blocked because of the necessity for the approval of the Transit Commission. It is difficult to see how the deadlock can be broken except by further legislation or by a political overturn, either in the state or the city. The outlook for actual transit extension in the near future is, therefore, not overbright.

The announcement of Mayor Hylan's transit plan makes no reference to any engineer or other technical advisor, as being responsible for, or associated with, its preparation.

Part of Pacific Highway Paved 27 Ft. Wide

A portion of the Pacific Highway extending 4.9 miles to the north from the city limits of Seattle, Wash., is being paved with concrete 8 in. thick and 27 ft. wide. The work is being done by the Washington Department of Public Works, Division of Highways, and is one of those projects on which federal-air funds are used. The paving is being placed in two 13½ ft. sections with a ½-in. expansion joint between. The work is to be completed this fall at a total cost of about $46,800 per mile.

In order to accommodate traffic going through the city to this road, the city of Seattle has recently built within the city limits 5 miles of concrete paving 40 ft. wide and 8 in. thick, connecting with the Pacific Highway at the city limits.

The Engineer in Public Life

JOHN T. FULLER

Chief executive of an industrial community with a population varying from 2,500 to 7,000 is one of the duties of John T. Fuller, superintendent of the American Bauxite Co. at Bauxite, Ark. He was born in Wilkes Barre, Pa., Nov. 8, 1880, and was graduated from Lehigh University in the class of 1903. His experience has included service as engineer and mine manager with the DeBeers Consolidated Mines, Ltd., in South Africa, and with both American and Canadian mining companies.

At Bauxite the company owns the entire town, land and buildings, and Mr. Fuller's appointment as superintendent marked a reorganization of the whole method of town administration. He appointed a town manager and organized to operate under that official departments of police, fire, sanitation, streets, etc. Acting in an advisory capacity with the town manager is a town council chosen from among the best citizens, both men and women, of the community. A director of personal relations was another of Mr. Fuller's appointees and under his supervision departments of safety, labor, commissary, and medicine are operated. The whole scheme of town government developed by Mr. Fuller aims to avoid as far as possible any interference on the part of the company with its employees and to protect their rights and liberties as citizens of the community. Among other activities was the organization of school districts, serving about 600 pupils and requiring 18 teachers and three school buildings.

Washington Water Conduit Award

The War Department, through the chief of engineers, has authorized the award of a contract to the Arundell Corp., Baltimore, Md., for the construction of the new water conduit from Great Falls, Va., to the Dalecarlia reservoir at the District line, a distance of eight miles, at a cost of $2,058,725. Army engineers expect the work will begin Sept. 1, and be completed June 30, 1924. The construction will be of concrete.

Pittsburgh Creates Department of City Planning

A City Planning Commission has been appointed at Pittsburgh, Pa., with Morris Knowles, consulting engineer, Pittsburgh, as chairman, and Frederick Bigger, secretary. U. N. Arthur is chief engineer and Charles F. Miller is assistant chief engineer. Included in the nine members of the commission besides Mr. Knowles and Mr. Bigger, is Charles A. Findley, chief engineer of the Pittsburgh Department of Public Works.

Railroad Strike Now Key to Coal Supply

Congress Averse to Coal Legislation Unless Carriers Fall Short—Expect Anthracite Peace

Washington Correspondence

Principal emphasis is being placed by those opposed to legislation looking to the control of coal prices and distribution on the argument that such control no longer is needed. Many law makers are of the opinion that the situation is such that it can take care of itself. Those who favor the legislation might be willing to accept the argument if they were sure that the railroads could function at a high rate of efficiency. With the uncertainty as to railroad operation, however, they contend that this control must be established. They contend that at the end of price control in 1919 everyone was confident the situation would take care of itself but they point to the profiteering in coal in 1920 as a glaring instance wherein the government did not function in the protection of the public. They think the country is in much the same frame of mind now but they deprecate statements creating a false sense of security.

Coal Stocks Gone

Theoretically at least, all stocks of coal now have been wiped out. Whatever stocks there may be in fact are known to be negligible and too low to enter the winter with safety. The market cannot be expected to tranquilize until a considerable amount of coal has been put in storage. How soon such a point can be reached depends entirely on the service which the railroads can give. The American Railroad Association makes the ambitious estimate that the carriers can transport 9,000,000 tons weekly. At the National Coal Association it is thought that 8,000,000 tons is the maximum. Disinterested traffic men, however, point out that if coal shipments reach 8,000,000 tons of bituminous, in addition to the anthracite that is expected soon to be moving, and at the same time, the usual volume of other freight is handled, the railroads will have performed an extraordinary feat.

There is an increasing feeling among officials in Washington, however, that the railroad managements are not being entirely frank with them or with the public. They seem to think that the situation with regard to railroad equipment is much worse than the railroads are willing to confess, to say nothing of their ability to attain a high degree of efficiency with the morale of its employees in its present state. The attitude of the railroad executives is compared with that of the coal operators early in the strike, when they declared it would be crushed flat by July 1. The railroad management seems to be just as sure that the strike is beaten, but officials in Washington have evidences that the men are possessed of determination not to yield.

It is fully expected that an agreement will be reached promptly in the anthracite field and that the mines there will reopen after Labor Day. It is expected that the operators will recede from their demand for arbitration and that the men will be forced to recede from their demand for a two-year contract.

Convention Features, New England Water Works Association

Features of the forty-first annual convention of the New England Water Works Association to be held at New Bedford, Mass., Sept. 12-15, are a carefully selected list of papers, Superintendents' Day, two excursions, a golf tournament, and an exhibit by the manufacturers.

The water-works of New Bedford will be described and experiments with substitutes for lead as a jointing material for cast-iron pipe will be outlined by Stephen H. Taylor, superintendent of the New Bedford Water Works. Among the other papers scheduled are: "Service Pipes," by David A. Heffernan, superintendent of water-works, Milton, Mass.; "Cross Connections for Private Fire Protection," C. M. Saville, chief engineer, Hartford water-works; "Meter Setting and Maintenance," James A. McMurry, assistant engineer, Department of Public Works, Boston; "Legal Points in the Purchase of a Water Company," Henry A. Symonds, Boston; "Water Supplies of Southeastern Massachusetts," X. H. Goodnough, chief engineer, Massachusetts Department of Health; "The Water Supply of Fall River," H. K. Barrows, Boston; "A New Method of Purifying Water," Harry W. Clark, chief chemist, Massachusetts Department of Health; "The New Water Supply of Providence," Frank E. Winsor, chief engineer, Water Supply Board, Providence; and "Hydrogen-Ion Determination," Robert Spurr Weston, Boston.

One session will be devoted to high-pressure fire service. The Boston system will be taken up by Frank A. McInnes, engineer, Water Division, Boston. The underwriters' viewpoint will be presented by George W. Booth, chief engineer, Board of Fire Underwriters, New York City. There will be short statements by fire chiefs on the value of high-pressure service.

The first of the two excursions will be an automobile trip over the New Bedford water-works on Tuesday afternoon, and the second excursion will be on Thursday afternoon, by steamer on Buzzards Bay to Fairhaven, then by trolley to Fort Phoenix where a clam bake will be served at 7:15 p.m., after which there will be music and dancing, and finally a return trip to New Bedford by trolley.

Details of the golf tournament and other features are given in the programs of the convention, which may be obtained from Frank J. Gifford, secretary, Tremont Building, Boston.

Engineering Institute of Canada to Meet in Winnipeg

Arrangements for the thirty-sixth annual professional meeting of the Engineering Institute of Canada, which is to be held in Winnipeg Sept. 5-7 have been completed. Considerable attention is to be given hydro-electric development, and a luncheon is to be served at the plant of the Manitoba Power Co. An inspection of the Winnipeg hydro-electric power plant, followed by a dinner served by the Winnipeg Hydro System is another feature. Discussion will also be given railway terminals and highways as well as other engineering topics.

Start Construction on Lincoln Highway Ideal Section

Construction work on the Ideal Section of the Lincoln Highway between Dyer and Schererville, Ind., was begun this month under an agreement with Stone & Webster, Inc., of Boston, under whose direction J. C. O'Connor & Sons, of Fort Wayne, Ind., will build the concrete roadway. The design calls for a 40-ft. width, paved with a 10-in. thickness of reinforced concrete, which, with appurtenances, is estimated to cost $100,000 a mile.

Civil Service Examinations

UNITED STATES

Applications for civil service positions listed below should be addressed to the United States Civil Service Commission, Washington, D. C., or to any local branch of the Civil Service Commission.

For vacancies in the Public Health Service: Technical assistant in Sanitary engineering, $1,500 to $1,800 per year; junior assistant sanitary engineer, $1,960 per year; and assistant sanitary engineer, $2,500, $2,800, $3,150 and $3,250 per year. Examinations (for junior assistant sanitary engineer and assistant sanitary engineer postponed from Aug. 9) Sept. 6.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.
NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.
AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.
AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.
AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Texas Section of the American Society of Civil Engineers will meet Oct. 20 and 21 at San Antonio. Seven subjects are scheduled for discussion among which are the following: "Strength of Concrete," by F. E. Giesecke; "Levee Building in Texas," by A. A. Stiles; "Report on Governor's Engineering Conference," by E. N. Noyes; "Bridge Problems of Texas Highway Department," by G. G. Wickline, and "The Water System of Corpus Christi," by C. J. Howard.

The Akron Engineering Council has been organized to co-ordinate the activities of all local engineering societies. The Council was organized by representatives from the Engineering Society of Akron, the American Association of Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. H. T. French of the Herberich-Hall-Harter Company, is chairman of the Council and R. R. Metheany, division engineer with the Pennsylvania R.R., is vice-chairman.

Personal Notes

E. H. QUINNEY, has severed his connection with the South Dakota Highway Commission by which he was employed as resident engineer, and has gone into business under the firm name of the Dakota Highway & Materials Co., Watertown, S. D.

J. G. G. KERRY, a consulting engineer of Toronto, Can., has been retained by the City of Vancouver, B. C., to report on a suitable site upon which a municipally-owned hydro-electric power plant is to be constructed.

JOHAN STÖRE, civil engineer, Christiana, Norway, whose experiments on the use of a large canvas hose to make temporary low dams as described in *Engineering News-Record*, May 26, 1921, p. 911, is visiting in this country.

ARTHUR BUX, until recently in the city engineer's office of Springfield, Ill., has been appointed city engineer of Manhattan, Kan. He will assume his new duties Sept. 1.

T. D. MYLREA, for the past few years employed by Norman McLeod, Ltd., engineers of Toronto, Ont., and formerly in the city architect's office, has been appointed assistant professor of structural engineering at the University of Illinois.

THOMAS M. HATCH, formerly of the Summitt Construction Co., is now a member of the Sterling Constructors, street, highway and sewer contractors, of Akron, Ohio. Mr. Hatch has for some time been prominently identified with the Associated Pennsylvania Highway Contractors.

F. M. DOBSON has been elected professor of hydraulics at the University of Kansas to succeed Prof. Jones who recently resigned.

CHARLES D. CAMPBELL, for the past four years engaged in surveying and general engineering work in Hamilton, Ont., has been appointed city engineer of Belleville, Ont. Mr. Campbell is a graduate of the University of Toronto. He was former city engineer of Galt, Ont., and at the same time acted as resident engineer for the Galt, Hespeler & Preston Ry.

J. P. POPE, former chairman of valuation for the Southern Pacific Co., has been appointed consulting valuation engineer for the company's Pacific System, effective immediately. Other valuation department appointments announced by the company are: G. E. B. WELLES, supervisor of land valuation, appointed engineer of land valuation with jurisdiction over land valuation work; and J. H. BAKER, office engineer, valuation department, appointed assistant engineer of valuation with jurisdiction over engineering valuation matters. These three men will

continue to make their headquarters in San Francisco.

ROLLEN J. WINDROW, of Kansas City, a consulting engineer in the service of the Missouri State Highway Commission, was in Washington, D. C., last week conferring with officials of the Bureau of Public Roads in regard to Missouri projects and plans.

C. E. DARE, who for more than two years has been a resident engineer for the Richmond, Fredericksburg & Potomac R.R. Co., has been made engineer of maintenance-of-way. His appointment became effective Aug. 15.

COL. SPENCER COSBY, Corps of Engineers, U. S. Army, has been relieved from duty and station at Savannah, Ga., and assigned to duty at Cleveland, Ohio.

A. W. BUFORD, formerly employed by the U. S. Bureau of Public Roads as highway bridge engineer, has recently been appointed district engineer by the Arkansas State Highway Department.

ALEJANDRO BARRIENTOS, of Havana, Cuba, has been appointed chief engineer of the Province of Havana.

EARL LEWIS MOSLEY, who during the past year has been with the engineering department of the City of Colorado Springs, Colo., as field and office engineer, has been appointed superintendent of construction on the new Colorado Springs city auditorium. Work on the structure, the estimated cost of which is $315,000 began Aug. 5.

C. J. LAUGLIN, former construction bridge engineer for the South Dakota Highway Commission, has resigned to engage in private practice.

CARLOS W. DEL PLAINE, a civil engineer of Minneapolis, Minn., has joined the League of Minnesota Municipalities as field agent, according to a recent announcement by the executive committee.

E. M. HASTINGS, principal assistant engineer of the Richmond, Fredericksburg & Potomac R.R. Co. since March, 1920, has been made chief engineer. His appointment was effective Aug. 15. Prior to being appointed principal assistant he was resident engineer for the road.

D. M. FERLET, assistant engineer of the Terrell Independent Road District, Terrell, Tex., has been made resident engineer, succeeding T. B. TARTT, who has returned to Central America to engage in railroad work.

S. F. FERGUSON has withdrawn from the firm of Nicholas S. Hill Jr. and S. F. Ferguson, consulting engineers, New York, the partnership being dissolved Aug. 31. The firm's consulting practice will be continued by Mr. Hill.

OBITUARY

ALPHEUS P. HANSON, who served four terms as surveyor-general of the state of Wyoming, died in Hollywood, Cal., Aug. 21, aged 66 years.

PROF. AXEL E. BERGGREN, of the department of steam and gas engineering of the University of Wisconsin College of Engineering, died Aug. 10 as the result of injuries received in an automobile accident. Prof. Berggren had been connected with the college of engineering since 1910. He was a graduate of Iowa State College.

HARRY S. RENKERT, president of the Metropolitan Paving Brick Co., of Canton, Ohio, died in Geneva, Switzerland, Aug. 20.

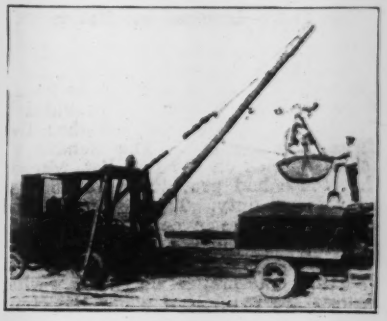
GEORGE J. SATTERLEE, of Brooklyn, N. Y., for the past several years employed by the Department of Water Supply, Gas and Electricity of New York City, at the Gravesend pumping station, died suddenly in Brooklyn, Aug. 21, aged 53 years.

WINSLOW BARNES WATSON, who served as a captain in the 27th Division during the World War, was drowned recently near Plattsburgh, N. Y. He was a graduate of Union College and had been engaged in engineering work on the Panama Canal, and later the construction of the New York State Barge Canal. At the time of his death he was supervising a dam-construction project for the Bluff Point Stone Co. on Mead Brook. He was 42 years of age.

EQUIPMENT AND MATERIALS

Mounts Crane on Truck Chassis

To increase the movability of small cranes the Byers Machine Co., Ravenna, Ohio, has brought out the "Truckrane," which consists of a crane weighing 6 tons mounted on a truck chassis. The



crane has a 30-hp. gas engine and ½-yd. bucket and is similar to the Byers auto-crane model 1 except that it has no wheels, jack shaft, differential or drive chains.

Out-of-the-Ordinary Trade Publications

Freight Elevator Doors—THE PEELLE CO., New York, in a 48-page illustrated catalog, presents the advantages of its counterbalanced freight-elevator doors, safety appliances and interlocking systems. The door consists of a tin-covered wood core and is divided horizontally in the center. The two panels, one moving up and the other down inside the hatch, save floor space and afford full clearance for loading. When the door is open a heavy "truckable" steel bar on top of the lower panel and flush with the floor closes the 4-in. gap between the door-opening saddle and the elevator car, allowing loads to be wheeled over it without impact. The company manufactures also a self-sealing smoke-proof pass type door, approved by the Underwriters' Laboratories. It is designed for buildings where story-heights are limited. In this type one leaf slides over the other on rails and guide shoes and forms a smoke-tight seal. The catalog also describes corrugated steel counterbalanced doors and panel types of various kinds.

Turntable — THE CHAMPION ENGINEERING CO. has issued a leaflet illustrating by photographs the uses of its automatic turntable for handling motor trucks on road construction. The feature of the equipment is its automatic operation. The truck drives up on the turntable and without stopping the motor or changing gears its rear wheels are made to rotate tread wheels which propel the upper structure of the turntable. Locking devices insure safety of operation. The turntable will handle trucks weighing 15 tons and with a wheelbase of 166 in. Transfer rollers are provided for towing the turntable short distances while detachable wheels are furnished for long-distance movements.

Screw Insert Plugs — THE RAWLPLUG CO., New York, describes in an illustrated folder its jute fiber insert plugs for holding screws in any material, such as a brick, concrete or tile wall. The "rawlplugs," as they are called, are cylindrical in shape with a hole through the center, and are manufactured in a variety of lengths and diameters. The company also makes a drill for forming holes into which the plugs are inserted. Standard wood screws are then screwed in, their entrance expanding the jute fiber, compressing it against the sides of the bore and forming a tight fit.

Concrete Block Machinery—THE J. B. FOOTE FOUNDRY CO., Fredericktown, Ohio, sets forth details of its line of Panama concrete and block-manufacturing machinery in a 40-page illustrated catalog. Both hand-power and machine-driven batch and continuous mixers are described, with capacities varying from 3 cu.ft. upward. Molds for ornamental block of a number of styles are pictured and the process of block manufacture with the company's machine is illustrated. The text contains practical suggestions on the use of concrete block for residential buildings, garages and silos.

Fumes in Mining—THE HERCULES POWDER CO., Wilmington, Del., is distributing in the form of a 43-page multigraphed pamphlet a paper by J. Barab entitled, "Fumes Encountered in Mining Operations and Handling of Explosives." It is a compendium of valuable information from many sources, dealing with coal and metal mines and rock tunnels. The text discusses fully the products of explosion and the physiological effects of gases, and curative measures.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Senate Tariff Duties on Construction Materials

Rates Generally Higher Than Under Existing Law But Lower Than Those Imposed by House

Construction material of nearly all classes bears a lower rate of duty in the tariff bill as passed by the Senate than the rates which were provided by the House, but generally higher than under existing law. The Senate put common brick on the free list, whereas the House had provided a 10 per cent ad valorem duty. The Senate imposed a duty of 25 per cent on fire brick, chrome brick and bath brick and a duty of ⅜c. per lb. and 10 per cent ad valorem on magnesite brick, which figures are reductions under the House rates, but are materially greater than the duties under the existing Underwood tariff.

Under the Senate bill, tiles will bear a duty of from 5c. per sq.ft. to 50 per cent ad valorem, according to value, which are about the same rates as fixed by the House and are approximately double the rates of the existing law.

While the Senate retained all building cements on the free list, the House bill provided a duty of 5c. per 100 lb. on Portland, Roman and other hydraulic cement in packages and 4c. if in bulk, and a duty of 17 per cent ad valorem on other cements. No change was made by the Senate in plaster cements, so that the House rates will stand in the bill. The Senate, however, placed plaster rock or gypsum in the crude on the free list, whereas the House bill had provided 25c. per ton duty. The rates in the bill, which will be unchanged in conference, are $1.40 per ton on ground or calcined plaster rock or gypsum; 8c. per 100 lb. on white non-staining Portland cement, and $3.50 to $14 per ton, according to value, on Keene's cement and others of which gypsum is the component material of chief value.

Rates on comon window glass are fixed in the pending bill, the Senate having made no change in the House figures, which vary from 1¼@4c. per lb., according to the size. No change was made in the House rates on fluted or other rough plate glass used for sky-lights, fire windows and similar construction, the rates starting at ¾c. per sq.ft. for not exceeding 184 sq.in. and advancing progressively according to both size and weight. The Senate, however, increased the House rates on cast polished plate glass for office buildings and similar uses, the minimum being 12½c. per sq.ft. and the maximum 17½c., while if containing a wire netting the rates range from 15 to 20c. per sq.ft.

A reduction was made by the Senate on granite, freestone, sandstone and other building stone, except marble, breccia and onyx, if dressed or polished. The Senate rate is 50 per cent, which is lower than the House rate of 40 per cent, because it is based on foreign valuation while the House basis was American valuation. The rate on the rough is 15c. per cu.ft. House rates on marble, breccia and onyx were not changed and these will stand in the new tariff law, being 65c. per cu.ft. if in the rough and from 8 to 10c. per superficial foot if in slabs.

The new rates on lime also are definitely known, as the Senate made no change in the House figures and these will stand in the new tariff. The rate on crude limestone, crushed but not pulverized, is 5c. per 100 lb.; common lime, 10c., hydrated lime, 12c. per 100 lb.

Rates on slate, including all manufactures of slate, were reduced by the Senate from 17 to 15 per cent ad valorem, which is a greater reduction than the figures indicate because of the change also from American to foreign valuation.

Lumber was left on the free list by the Senate, which also sent to the free list hewn timber, 8 in. or more, on which the House had imposed a duty of ⅛c. per cu.ft., and logs of fir, spruce, cedar or Western hemlock, on which the House had adopted a duty of $1 per M. ft. b.m. While logs of veneer woods remain on the free list, the Senate wrote into the bill a duty of 15 per cent on them if sawed into boards or otherwise advanced, and imposed a duty of 20 per cent on veneers. Shingles, on which the House had imposed a rate of 50c. per thousand, were placed on the free list by the Senate.

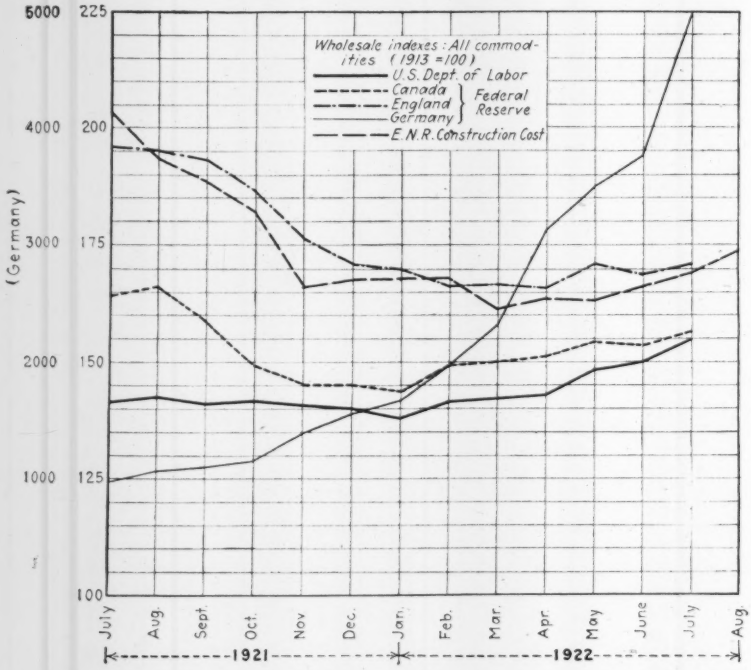
In the last week the tariff bill was under consideration in the Senate, the finance committee reduced the rate on structural steel and iron, if not advanced beyond hammering, from the House rate of $\frac{7}{10}$@⅛c. per lb., and reduced to 20 per cent ad valorem the

(Concluded on p. 376)

Trend of Wholesale Prices Upward Since June

Indexes of "All Commodities" In U. S., Canada, England and Germany Point to Higher Levels

The trend of wholesale prices of all commodities continued upward throughout July, according to information gathered in representative markets of the country by the U. S. Bureau of Labor Statistics. Based on 404 commodities, or series of quotations, the Bureau's weighted index number rose from 150 in June to 155 in July, a gain of 3⅓ per cent. The increase from May to June was 1⅓ per cent.



The Federal Reserve index number of wholesale prices in Canada, constructed for the purpose of international comparisons, showed an increase of four points or 2.6 per cent during July (100 in 1913) and now stands at 157. This shows Canadian prices to be running somewhat lower than American prices in terms of the respective currencies.

The index number of wholesale prices in England, constructed by the Federal Reserve Board, returned in July to the May level of 171, by an increase of two points. Using 1913 as a base, prices in England are slightly higher than American prices in terms of the respective currencies. When converted to a gold basis, English prices for the last three months have ranged from 2 to 5 per cent lower than American prices.

The Federal Reserve Board has received a wireless from the American Commissioner in Germany, giving July wholesale and retail price indexes of the German Federal Statistical Office

Bituminous Coal Prices Showing Downward Trend

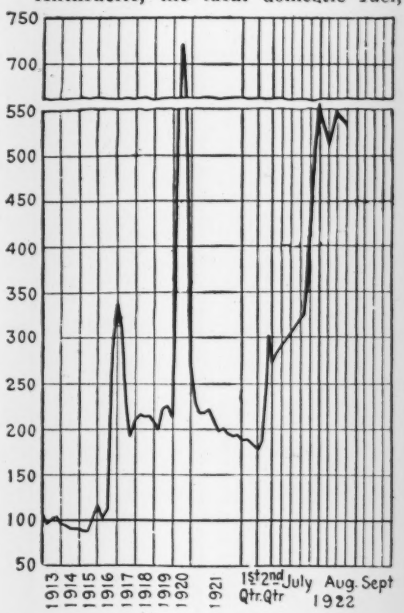
The trend of bituminous coal prices is shown in the *Coal Age* index chart here reproduced. This diagram shows the relative, not the actual, prices on fourteen coals, representative of nearly 90 per cent of the total output of the United States, weighted in accordance first with respect to the proportions each of slack, prepared and run-of-mine normally shipped and second, with respect to the tonnage of each normally produced. The average thus obtained was compared with the average for the twelve months ended June, 1914, as 100, after the manner adopted in the report on "Prices of Coal and Coke, 1913-1918," published by the Geological Survey and the War Industries Board.

Bituminous prices, which soared during the height of the strike, are now on the decline with the heavier offerings, and the end is not yet. They will not, however, recede much further, as industry must replenish its reserve, depleted through the twenty-one weeks of the bituminous coal tie-up.

From Monday, Aug. 21, to Thursday, Aug. 24, inclusive, coal loadings totaled 73,768 cars, an increase of 19,082, or 35 per cent, over the total for the first four days of the week preceding. This represented the largest number of cars loaded with coal during any four day period since the miners' strike began on April 1, last. At this rate, production would be approximately 6,000,000 tons per week or 725,000 tons in excess of the best previous week, which was in June, when there was no strike of railway shopmen in effect.

The increase in coal loadings was due principally to a resumption of mining in the Ohio bituminous fields, resulting from the agreement recently reached by the miners and the operators at their conference in Cleveland. Shipments also increased in the Eastern and Allegheny region, where agreements have been reached by union officials and certain coal operators.

Anthracite, the ideal domestic fuel,



is used almost exclusively as such in the sections within a reasonable freighting distance of the hard-coal mines. Anthracite mining has been paralyzed since April 1. A substitute fuel is therefore necessary, until anthracite production is resumed and the coal begins to seep through to the householder. Coke will be utilized as well as soft coal.

Twenty-five Big Contracts Total $26,797,892

$15,390,897 For Building Construction Alone—Six Industrial Projects Reach $6,000,000

A list of twenty-six important jobs awarded in February and March was published in the Searchlight Advertising section of the April 20 issue of *Engineering News-Record*. Following this, a table showing fifty big projects placed under contract from March to June, and aggregating $81,960,860, was published in the July 27 issue, p. 169.

The accompanying table shows twenty-five big contracts awarded since June, representing a total value of $26,797,892, over 57 per cent or $15,390,897 of which was for building construction.

There were six industrial projects, aggregating $6,000,000 or 23 per cent of the total for these twenty-five contracts.

Three bridge jobs reach $1,138,410, and three water-works contracts, $2,325,000.

The total value of large engineering contracts let, throughout the United States and Canada, for the week ending Aug. 17, amounted to $34,300,000. Buildings alone totaled $17,307,000 with streets and roads second with $9,605,000.

Industrial projects amounted to $3,387,000 and water-works $1,014,000.

Contracts valued at $9,363,000 were awarded in the Middle West, with $8,793,000 for the Middle Atlantic States. The Southern States came third with $5,004,000 and lettings to the value of $4,547,000 were located in the group west of the Mississippi. Figures for the entire month will be published in the Sept. 7 issue.

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE JUNE

Place	Work	Size	Price	Successful Contractors
Bahamas, Nassau	Hotel		$1,000,000	Purdy & Henderson, 45 E. 17th St., New York.
Calif., Palmdale	Dam	700 ft. long, 145 ft. high	500,000	Bent Bros., 1714 Eagle St., Los Angeles, Calif.
Calif., San Diego	Theatre and Office	7 stories	1,054,000	Lange & Bergstorm, Tinker Bldg., San Diego, Calif.
Calif., Watts	Sewerage system		442,775	A. W. Phillips, 573 North Hoover St., Los Angeles, Calif.
Conn., Stamford	Water-works		750,000	H. Steers Corp., 17 Battery Pl., New York.
Conn., Thompsonville	Plant		1,000,000	L. E. Locke & Sons Co., South Union St., Lawrence, Mass.
Ill., Chicago	Apartment	10 story, 140 x 170 ft.	2,000,000	Mueller Constr. Co., 179 West Washington St., Chicago, Ill.
Ill., Chicago	Apartment	10 story, 102 x 230 ft.	1,500,000	Schmidt Bros. Constr. Co., 22 East Huron St., Chicago, Ill.
Ill., Chicago	Plant	6 story, 120 x 280 ft.	1,000,000	G. A. Fuller & Co., 140 S. Dearborn St., Chicago, Ill.
Ind., Ft. Wayne	Bank	12 story	900,000	M. Irmacher & Son, 118 W. Berry St., Ft. Wayne, Ind.
Ind., Michigan City	Factory	400 x 500 ft.	1,000,000	Witherspoon-Engler Co., 53 W. Jackson St., Chicago, Ill.
Mass., Boston	Bridge	790 ft. long	599,150	Crandall Eng. Co., East Boston, Mass.
Mass., Lawrence	Plant	6 story, 100 x 500 ft.	500,000	Turner Constr. Co., 178 Tremont St., Boston, Mass.
Mich., Detroit	Theatre & Office		2,000,000	J. Finn & Son, 708 Amsterdam Ave., Detroit, Mich.
Minn., Duluth	Plant & Warehouse	6 story, 200 x 500 ft.	1,000,000	Jacobson Bros., 406 Columbia Bldg., Duluth, Minn.
Minn., St. Paul	Hotel	16 story, 99 x 112 ft.	1,600,000	Smith & Vandanaker, 501 Exchange Park Bldg., St. Paul, Minn.
N. J., Jersey City	Warehouse	6 story	2,000,000	Lynch Constr. Co., 52 Vanderbilt Ave., New York.
N. Y., Brooklyn	School		1,336,897	Werner-Disken Co., 50 Court St., Brooklyn
N. Y., Green Island, (Troy P. O.)	Plant		2,000,000	F. T. Ley Co., 495 Main St., Springfield, Mass.
N. Y., Long Island City	Piers & Bridge		268,900	P. T. Cox Contg. Co., 154 Nassau St., New York
N. Y., New York	Department Store	9 story	2,000,000	Cauldwell-Wingate Co., 381 4th Ave., New York.
Pa., Moosic	Waterworks		1,000,000	Winston & Co., Amer. Bank Bldg., Richmond, Va.
Pa., Williamsport	Bridge	1500 ft. long	271,170	Bethlehem Steel Bridge Co., Bethlehem, Pa.
Que., Montreal	Water-works	25,000,000 gal. reservoir	575,000	E. G. M. Cape & Co., 10 Cartheart St., Montreal, Que.
W. Va., Ronceverte	Plant		500,000	J. G. White Eng. Co., 43 Exchange Pl., New York.
Total			$26,797,892	

Trend of Wholesale Prices

The price trend shown in the chart is weighted according to the consumption of a workman's family at present, including food, fuel, light and rent.

The *Engineering News-Record* Construction Cost Index Number is here shown in comparison with the All Commodities Index Numbers of four nations. The general upward trend of prices since the first of June is graphically illustrated in the five ascending curves.

For Bid Prices on Actual Jobs See Construction News

A correspondent writes that he wants actual cost data on all kinds of construction and asks where he can find such data. Of course every important engineer, contractor and architect will have a certain amount of information applying to specific jobs in which he was interested, but the most comprehensive public reservoir of actual bids and prices is probably the Construction News section of *Engineering News-Record*.

There each week are published the important contract awards in all classes of engineering construction. Wherever possible, on outstanding projects, the unit bids of the three lowest bidders are presented in tabular form. Correspondents are instructed to send in lists of unit bids whenever available. In addition to the tables are the bids included in the contract-award items.

In the last three months unit-bid tabulations have been published for the anchorages of the Philadelphia and Camden bridge (p. 305, Construction News); the Clifton, N. J., sewerage system, p. 326; water-works improvements at Wellsville, Ohio, pp. 328 and 329; a road at Berkeley Springs, W. Va., and a tunnel on the Hetch Hetchy project in California, p. 9, July 6; road work in Florida, p. 17; and for several projects in this week's issue.

(Concluded from p. 374)

duty on structural steel and iron if machined, fabricated for use, or otherwise advanced beyond hammering. The duty on high-speed steel was reduced 7 per cent below the original recommendations of the finance committee two days before the bill passed.

Duty on building forms, sashes and frames of steel or iron was reduced to 25 per cent.

Rates on structural steel in the pending tariff bill are materially higher than under the existing law, which provides a duty of 10 per cent ad valorem.

The Senate cut the House rate on pig iron from $1.25 to 75c. per ton and the rate on scrap iron and steel from $1 to 75c. per ton. These items are on the free list under the existing law.

The Senate reduced to 15 per cent the duty on steam engines.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.93	$3.65	$4.20	$2.92½	+$3.05	$3.70	+$3.25	$3.75	$3.75
Structural rivets, 100 lb	3.85	4.35	6.00	3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb	2.83	3.50	3.50	2.82½	+2.95	3.67½	+3.00	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	+57%	61.15%	45%	59½%	+58.1-5%	43%	+45.7@49.1%	50%	30.00
Cast-iron pipe, 6 in. and over, ton	53.30	49.00	51.50	45.20	52.00	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.60	2.50	2.25	2.05	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	12.00	+1.75	1.75	2.25	1.00	1.50
Sand, cu.yd	1.00	1.15	2.25	12.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+53.00	40.00	40.00	47.00	40.00	50.00	+33.00	23.00	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	—21.30@23.50	11.00	10.90	11.00	+18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	+.09	.087	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	....	.087	.108	.11	.09
Linseed oil, raw, 5 bbl. lots, gal	.91	.97	1.13	.99	−1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.93 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

A 20 per cent wage advance in the steel mills, effective Sept. 1, bringing the rate to 36c. as against 30c. per hour, will also result in an advance of about $4 per ton in steel prices. Structurals are now quoted at $2@$2.10, f.o.b. Pittsburgh, with an absolute minimum of $1.90 for reinforcing bars, on all new business. Steel structurals are scarce; with fabricators quoting on no deliveries before the end of the last-quarter. Shape mills are mostly out of the market on current business. This week, San Francisco warehouses announce an advance of 15c. on steel shapes, followed by a rise of 10c. per 100 lb. on shapes and bars in Minneapolis. Last week, similar advances occurred in Chicago, Dallas and New York; Denver having quoted a rise during the preceding week. Wrought-steel pipe discounts dropped three points on black and two on galvanized on the new Pittsburgh basing card of Aug. 23. Accordingly, similar reductions in pipe discounts occurred in New York, Minneapolis and San Francisco warehouses.

Reports received up to Aug. 24, by the National Lumber Manufacturing Association, show many mills already beginning to decline orders, car shortages causing shipments to run as much as 16 per cent below production, despite the fact that August is the second best lumber month in the year. Long leaf yellow pine, base sizes, quoted in New York at $53 as against $51@$52 and Douglas fir at $33 as compared with $31 per M. ft. b.m. in San Francisco.

Common brick now $18@$20 in New York as against $20 per M., alongside dock, indicating a gradual downward trend in this market. Minneapolis, however, quotes an advance of $1 per M., over the week end. The decrease in New York is due to a slight falling off in demand rather than an increase in production. In view of the present fuel emergency, brickmakers in the districts supplying New York have tried a combination of coke and anthracite coal, finishing with bituminous. Imperfect brick turned out by this process have sold, in odd lots, as low as $17 per M.